A framework for enhancing the design skill sets of Foundation Programme Landscape Architecture students

by

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Declaration

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Abstract

Every person has the potential to be creative, but this often only happens if the conditions for developing creativity are favourable. Hence, it can be argued that educators are responsible for creating a teaching and learning environment that fosters and encourages creative expression. Subscribing to the view that creative potential is a combination of various skills that can be learned and taught, and using the theoretical perspective of Multiple Intelligence (MI) Theory, this Design-Based Research (DBR) study endeavoured to develop a design skill set enhancement framework to improve access to and success in Landscape Architecture studies.

The context for the study was the Cape Peninsula University of Technology (CPUT), South Africa. The research was conducted during 2017 with the student cohort registered for the Foundation Programme in the Diploma in Landscape Architecture at CPUT. The study comprised iterative cycles of design, implementation, analysis, and review. During each iteration, pre- and post-intervention data gained from design assignments, Participatory Action and Learning (PAL) projects, as well as informal and unstructured interviews were analysed and compared.

The rigorous in-depth interpretation of the data, and more specifically the data of three randomly selected student participants, produced encouraging results. The interpretation delved deeply into the design skill set heuristics that emanated from the multiple intelligence conjecture-driven teaching experiment. Importantly, the design skill set framework merged the two components, i.e. the design knowledge semiotic process and the design skill set modal agencies, into the modal agency meaning making process. Exposing the participants to the different modalities, through the approach of teaching to, for and through their preferred skill sets, not only supported them to experience learning in ways they are most comfortable with, but also challenged them to learn in other ways, thus enhancing their underdeveloped design skills. Multiple modal entry points shifted the attention away from underdeveloped skills as barriers to teaching and learning to engage the interest of students and facilitate the development of design skills of students with disparate abilities.

The implementation of the modal agency meaning making process in an authentic, domain specific environment facilitated the participants' skills and knowledge development, by bridging the gap between the understanding of theoretical knowledge concepts and the real life application of those concepts. Extending learning beyond the physical architecture of space into a psychosocial, collaborative learning environment that encourages a diversity of approaches to identify and solve problems, demonstrated that both skills acquisition and information processing reinforce and expand a student's creative ability and perceptions.

In addition to the primary contribution of the study in the form of the proposed framework, five design principles were identified, providing insight into the function and key characteristics of the design skill set development framework intervention, as well as the procedural conditions guiding implementation. It is clear that the design skill set framework is a feasible and effective teaching and learning strategy that can be adapted for application in various contexts.

Opsomming

Elke person beskik oor die potensiaal om kreatief te wees, maar dit geskied dikwels slegs in omstandighede wat gunstig is vir kreatiwiteitsontwikkeling. Daar kan dus geargumenteer word dat dit die verantwoordelikheid van opvoeders is om 'n onderrig- en leeromgewing te skep wat kreatiewe uitdrukking aanmoedig en bevorder. Hierdie Ontwerpgebaseerde Navorsingstudie vertrek van die uitgangspunt dat kreatiewe potensiaal uit 'n kombinasie van verskeie vaardighede bestaan wat geleer en onderrig kan word, en maak gebruik van die teoretiese perspektief wat bekend staan as die Veelvuldige Intelligensie Teorie. Die doel van die studie was om 'n raamwerk te ontwikkel wat ontwerpvaardighede van studente sal bevorder en so sal bydra tot verhoogde toegang tot en sukses in Landskapsargitekstudies by die Kaapse Skiereiland Universiteit van Tegnologie (KSUT) in Suid-Afrika.

Die navorsing is gedurende 2017 uitgevoer met die studente wat vir die Grondslagprogram van die Diploma in Landskapargitektuur by KSUT geregistreer was. Die studie het bestaan uit iteratiewe siklusse van ontwerp, implementering, analise en oorsig. Tydens elke siklusherhaling is pre- en post-intervensie data, wat ingewin is uit die ontwerpopdragte, die Deelnemende Aksie- en Leerprojekte (DAL), asook die informele en ongestruktureerde onderhoude, geanaliseer en vergelyk.

Die nougesette in-diepte interpretasie van die data, veral die data van drie studente wat op lukrake wyse geselekteer is, het belowende resultate opgelewer. Die interpretasie het diep gedelf in die heuristiek van die ontwerpsvaardigheidstel wat voortgevloei het uit die veelvuldige intelligensie veronderstellingsgebaseerde onderrigeksperiment. Van belang is dat die raamwerk vir die ontwerpsvaardigheidstel die twee komponente, naamlik die ontwerpskundigheid semiotiese proses en die ontwerpsvaardigheidstel modale bemiddeling in die modale bemiddeling betekenisskeppende proses laat saamsmelt het. Blootstelling van die deelnemers aan die onderskeie modaliteite deur middel van onderrig van, vir en deur hul voorkeur-vaardigheidsstelle, het dit nie alleen vir hulle moontlik gemaak om onderrig te ervaar op maniere waarmee hulle die beste vertroud was nie, maar is hulle ook uitgedaag om op ander wyses te leer, waardeur hulle onder-ontwikkelde ontwerpsvaardighede uitgebrei en versterk is. Meervoudige multi-modale intreevlakke het die fokus verskuif van onderontwikkelde vaardighede wat as 'n versperring dien vir leer en onderrig na maniere om die belangstelling en vermoëns van die studente aan te wakker en die ontwikkeling van ontwerpsvaardighede van studente met uiteenlopende vermoëns te bevorder.

Die implementering van die modale bemiddeling betekenisskeppende proses binne 'n outentieke, domein-spesifieke omgewing het die deelnemers se vaardigheids- en

kennisontwikkeling bevorder, deur die gaping tussen die begrip van teoretiese kenniskonsepte en die toepassing daarvan in die werklike lewe te oorbrug. Hierdeur is die leerproses verder as die fisiese argitektuur van ruimte uitgebrei na 'n psigo-sosiale samewerkende leeromgewing wat 'n diversiteit van benaderings tot die identifisering en oplossing van probleme aanmoedig. Dit bevestig dat beide vaardigheidsverwerwing en inligtingsprosessering 'n student se kreatiewe vermoëns en persepsies versterk en uitbrei.

Bykomend tot die primêre bydrae van die voorgestelde raamwerk, het die studie ook vyf ontwerpbeginsels geïdentifiseer wat insig bied in die funksie en sleutelkenmerke van die ontwikkelingsraamwerkintervensie vir ontwerpvaardighede, asook die prosedurele voorwaardes wat as wegwyser vir die implementering daarvan dien. Dit is duidelik dat die ontwerpvaardigheidsraamwerk 'n werkbare en effektiewe leer- en onderrigstrategie is vir toepassing in verskeie kontekste.

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List of Abbreviations

CPUT	Cape Peninsula University of Technology
DBR	Design-Based Research
DHET	Department of Higher Education and Training
ILASA	Institute of Landscape Architects South Africa
LA	Landscape Architecture
MI	Multiple Intelligences
MIDAS	Multiple Intelligence Development Assessment Scale
PAL	Participatory Action and Learning
SACLAP	South African Council for the Landscape Architectural Professions

Chapter 1 :
ORIENTATION TO THE STUDY

1

1.1 Introduction

The dawn of the new South Africa in 1994 brought about a vision of 'a better life for all'. It is this dream of improving the South African society that affords the profession of Landscape Architecture untold opportunities (Stoffberg, Hindes & Muller, 2013). Landscape Architecture in South Africa is a young, dynamic and growing profession. Considering South Africa's geographic location, as well as our political history, Landscape Architecture is faced with unique environmental, social and economic challenges which require critical thought and strategic input to effect changes – in perceptions, in attitudes, and in human living conditions, underscored by both environmental and humanist values (Gibbs, 2008). Approximately 350 landscape architects have graduated from South African universities over the last 40 years, and the profession currently relies on only 130 registered professionals practising countrywide to address the challenges mentioned above.

Against this background it comes as no surprise that the South African Council for the Landscape Architectural Professions (SACLAP) identified a growing need for transformation and growth in this profession (Volmer, 2016). A prerequisite for this transformation of the profession is widened access to and success in higher education studies in Landscape Architecture. Access to Landscape Architecture studies is currently limited to only two traditional universities: the University of Pretoria with an undergraduate and a Master's degree in Landscape Architecture and the University of Cape Town with a Master's degree in Landscape Architecture. In addition, one University of Technology, the Cape Peninsula University of Technology (CPUT), presents a Diploma in Landscape Architecture.

1.2 Statement of the problem

Internationally the imperatives for access and fair chances of success have given rise to criticism of undergraduate design programmes for being inaccessible and for catering only for a narrow group of designers with specific skill sets and design aptitudes (D'souza, 2009). The mismatch or gap in design skill sets that the majority of students in undergraduate design programmes experience, is widened by low design exposure and under-preparedness to study this specialist discipline/field of study. This is a universal trait of students registered for design-based qualifications at higher education institutions internationally (Cidre, 2014). Current design teaching also contributes to this gap, because of the inappropriate assumptions about students' prior knowledge that do not take sufficient account of the wide range of educational preparedness of students and what they require to bridge the transitions from school to university and between various phases of undergraduate study.

In the South African context, low design exposure and under-preparedness are exacerbated by the demise of art and design teaching in the school system. Cadle (2009) found that only 12 schools out of 337 in the Nelson Mandela Metropolitan Municipality offered art as an option. Further evidence of this lack of exposure to art or design can be seen in the schools of Soweto in Gauteng, where there is only one secondary school offering art up to Grade 12 (Saidi & Nazier, 2011). Cowan (2000), from the Western Cape Education Department, posits that there is a crisis in art education in the public education sector and that the education system, dedicated to transformation, has downplayed the importance of visual art and design in the curriculum.

The primary focus of Landscape Architecture design programmes, both locally and internationally, is on developing skill sets through disciplinary content. 'Skill sets' can be defined as an umbrella term that includes various commonly used terms such as ability (skill to do something), aptitude (natural ability), competency (the ability to do something well), intelligence (ability to learn and understand) and creativity (the ability to make new things) (D'souza & Chandrasekhara, 2014). Although novice design students are initially unable or struggle to understand the design process or to communicate these ideas, Cidre (2014), Moore (2003) and Çubukcu (2010) argue that design skills are not inherent and can be developed. Moore (2003), for example, draws useful distinctions between the kinds of knowledge, skills and ambitions that are implicit in the process of designing something and the design of something as a vehicle for expressing the creator's personal inclinations (cf. Kirchengast, 2012).

The peculiar character of the Landscape Architectural profession requires landscape architects to be familiar with a wide range of knowledge fields, extending from the field of natural sciences to that of artistic creativity (Gazvoda, 2002). The complexity of design tasks requires individuals to have a wide array of skills - for example spatial visualization, problem solving, verbal skills, communication skills, and interpersonal skills. Yet design education today seems to be limiting skills to form manipulation and graphical skills. These latter skills, although essential to design, predict only a part of a designer's application in real-world contexts. Identifying and recognizing multiple intelligences then become important to value and develop diversity in Landscape Architecture, to accommodate the variations of individual cognitive strengths and to implement diverse tools to develop different areas of design thinking (D'souza & Chandrasekhara, 2014).

In view of the contribution that Landscape Architecture has to make to the development of South Africa, transformation in Higher Education is required to address the current problem of limited access to the profession. The central research problem is that low design exposure and under-preparedness seem to hamper access to and success in Landscape Architecture studies.

1.3 Aim of the study

The primary aim of the study is to develop a design skill set framework to enhance access to and success in Landscape Architecture studies.

The objectives of the study are the following:

i. To investigate the required design skill sets for undergraduate design studies and more specifically design skill sets for Landscape Architecture studies nationally and internationally;

ii. To analyse the current design skill sets of students registering for the Foundation Programme in the Diploma in Landscape Architecture at the Cape Peninsula University of Technology (CPUT);

iii. To develop a framework to enhance the design skill sets of Landscape Architecture students; and

iv. To evaluate the effectiveness of the framework in enhancing the design skill sets of Landscape Architecture students.

This study will contribute to the limited body of research in Landscape Architecture education that is focusing on the issues of limited access and success, especially among first-year cohorts, with a specific sensitivity to the challenges faced by under-prepared students.

The primary research question, which the researcher had hoped to answer through this study, was thus: *How can a design skill set enhancement framework contribute to access and success in Landscape Architecture studies?*

1.4 Theoretical underpinning

This study used the Multiple Intelligence (MI) model of the educationist and cognitive psychologist, Howard Gardner, as a theoretical framework to map and analyse design skills of students registered for the Foundation Programme in the Diploma in Landscape Architecture at CPUT. Gardner (1989) posits that education systems focus only on logical and verbal intelligences and fail to address the academic and career needs of many students whose strengths lie outside these two intelligences. The theory of MI argues that humans are born with various intelligences, with specific intelligences being dominant and others recessive and with the potential to harness or develop all intelligences (Gardner, 1993). Gardner proposes eight discrete skills concerning the ways in which individuals take in information, retain and manipulate that information and demonstrate their understandings to themselves and others. The eight skills include verbal/linguistic, logical/mathematical, musical, spatial, bodily-kinesthetic, intrapersonal, interpersonal and naturalistic skills (D'souza, 2007).

Research done by Chandrasekera, Vo and D'souza (2013) with architectural design students in the United States of America (USA), using Gardner's multiple intelligence framework, found that students possessed and applied a variety of skills during the design process, although these skills were not explicitly taught. The students also showed a balance of several different skills when compared with students from other disciplines. Moreover, architectural students with higher academic standing not only possessed a variety of skills, but also blended these skills and applied them in a meaningful way based on design problems and priorities of the context. The findings of the research indicate that design skills need not be restricted to one set of skills, but should rather be considered as a multiple intelligence framework that can be seen as an alternative way of accommodating individual differences and affording inclusive tools to tackle the diverse areas of design thinking.

1.5 Research approach

The present study is situated within a pragmatic paradigm (see Chapter 4 Section 4.3 for more detail), and to successfully address the primary aim of the study, a Design-Based Research (DBR) approach was implemented with the intent of producing new theories and practices that account for and could potentially impact teaching and learning (Reeves, Herrington & Oliver, 2005). DBR implies outputs in the form of both knowledge and products. These outputs must be in the form of scientific output (design skill set development principles), practical output (design skill set framework) and societal output (widening of access).

The research design, methodology and different measuring instruments are discussed in detail in Chapter 4 of this thesis. The study will consist of the four phases, as characterised by the DBR approach (Figure 1.1) (Reeves, 2006). The design phases are not carried out in a linear sequence but rather iteratively.

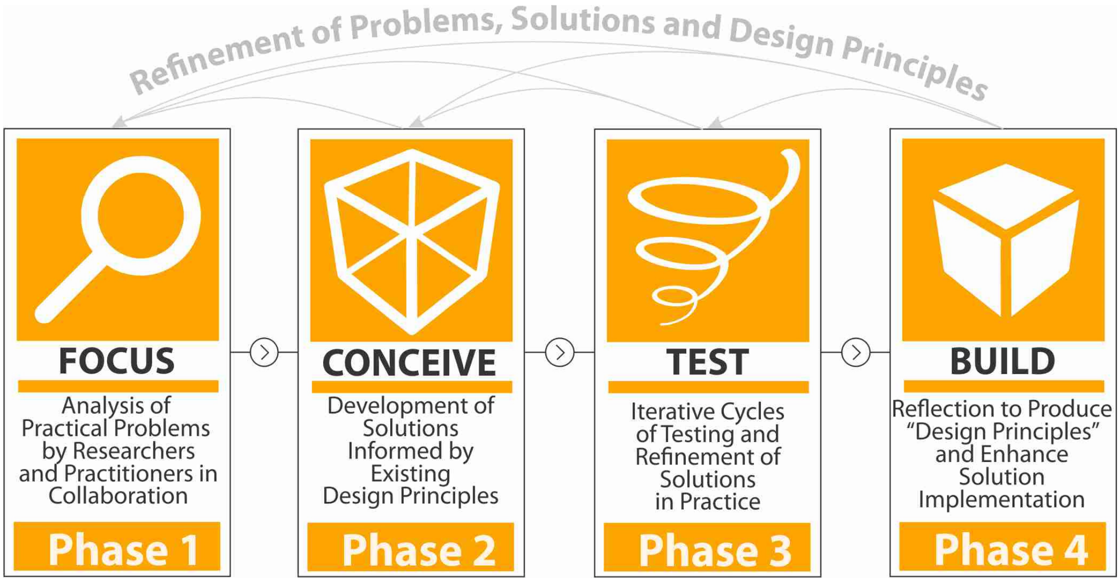

Figure 1.1: Design-Based Research Process

Figure 1.2 illustrates the connection between DBR as the proposed research methodology and the relevant chapters.

Phase 1 FOCUS	Analysis of Practical Problems by Researchers and Practitioners in Collaboration	**Chapter 1** Orientation to the study **Chapter 2** MI perspective on Design: - Creativity - Multiple Intelligence - Design Skills **Chapter 3** Design Education in Context: - Trends in Design education - Landscape Architectural education **Chapter 4** Research Design and Methodology: - Research Paradigm - Design-Based Research **Chapter 5** Analysis and exploration of the problem: - MI profile analysis - Pre-intervention Design skill set analysis
Phase 2 CONCEIVE	Development of Solutions Informed by Existing Design Principles	**Chapter 6** Development of a Design Skill set Enhancement Framework: - Existing Design Education Principles - Design Knowledge Semiotic Process - Design skill set Modal Agencies
Phase 3 TEST	Iterative Cycles of Testing and Refinement of Solutions in Practice	**Chapter 7** Implementation and Evaluation of a Design Skill set Enhancement Framework: - Iterative Cycle 1 - 4 - Reflection and analysis of each Iterative Cycle **Chapter 8** Retrospective Interpretation of Design Skill set Enhancement Framework: - Design skill set development narrative interpretation
Phase 4 BUILD	Reflection to Produce "Design Principles" and Enhance Solution Implementation	**Chapter 9** Conclusions and Recommendations: - Six design principles - Challenges, strengths and limitations - Contributions and future prospects

Figure 1.2: Research process

1.5.1 Phase 1: Analysis and exploration of the problem

***FOCUS**: sets the direction of the study. The design is meant to achieve an intended goal and there can be no meaningful goal without some problem or opportunity to address. Focusing ensures that there is something worth designing (Easterday, Lewis & Gerber, 2014).*

A comprehensive literature review of national and international research on design skill sets was undertaken to create a list of generic design skills students require for undergraduate design programmes (Chapter 2). A more specific literature review was then conducted on current understandings of existing design education principles on teaching and learning internationally and nationally (Chapter 3).

The research participants consisted of the Landscape Architecture Foundation Programme students of the 2017 cohorts in the Diploma in Landscape Architecture at the Department of Horticulture, CPUT (N=25). The whole population was used as the sample of analysis. Cognisance was taken of the complex ethical role of the lecturer-researcher, and the students had the option not to participate in the project.

The study was initiated by a pre-intervention survey that was conducted in the beginning of the academic year in 2017. The research instrument was a Multiple Intelligence Development Assessment Scale (MIDAS) questionnaire.

MIDAS was developed by Shearer (1997) and is intended to give a reasonable estimate of a person's intellectual disposition in each of the eight main intelligence areas (linguistic, logical-mathematical, spatial, musical, kinesthetic, naturalist, interpersonal and intrapersonal) (Shearer, 1997).

The Multiple Intelligence Development Assessment Scale (MIDAS) is a self- or other-completed questionnaire that can be administered and interpreted by psychologists, counsellors and teachers. There are five versions of the assessment for various age groups, from 4 years through to adulthood. The MIDAS questionnaire has been used as a survey instrument by various researchers, in different contexts and cultures internationally (Sulaiman, Abdurahman & Rahim, 2010; Stanciu, Orban & Bocos, 2011). D'souza (2007, 2009, 2011, 2015) used MIDAS in the Architectural context on American students while Akkuzu & Akcay (2011) applied it in a Computer Studies context on Turkish students.

The pre-intervention survey indicated the intellectual disposition of each of the students in terms of their design skill sets in relation to required design skill sets for students studying design. This was intended to highlight the contextual issue of poor design skill sets and how this lacking foundation contributes to low design exposure and under-preparedness.

A pre-intervention evaluation of the design skill sets of each participant was conducted a week before the first Intervention cycle was implemented. It consisted of three parts: design assignment 1, Participatory Action and Learning (PAL) project, and an informal and unstructured interview. The pre-intervention design assignment was to verify the existing development of the participants' design skill sets and design knowledge transfer. The design assignments were assessed according to the attributes of design ideas and design solutions (Chapter 5).

A Participatory Action and Learning (PAL) Assignment was implemented next to investigate the participants' perspectives on design Assignment 1. It consisted of two stages. During stage 1, the participants received an A3 page with colour pens and had to create a Moodline diagram that represented their emotional journey (how and what they felt) while executing the design assignment. In stage 2, the participants had to present their diagrams in a group.

1.5.2 Phase 2: Development of solutions using existing design principles

CONCEIVE: *a plan is sketched for the solution. This involves imagining a solution and analysing whether it will work. Testing the design against existing knowledge and theory to identify problems and improved solutions (Easterday, Lewis & Gerber, 2014). The distinction between the conceive and build phase is between that of a conceptual plan constrained only by the designer's knowledge and that of a concrete prototype that is at least partially functional and constrained by a medium (Easterday et al., 2014).*

The second phase focussed on a solution to the problem that can be implemented in a design educational setting. While a general literature review was conducted in the first phase that helped inform the exploration of the problem, a second literature review was done to find the relevant theory that can guide critical and creative thinking as well as existing design principles. Relevant learning theories together with existing design principles were considered to develop draft design principles that will guide the intervention (Chapter 6).

1.5.3 Phase 3: Implementation and evaluation of iterative cycles

TEST: *the efficacy of the solution was evaluated. The design must be implemented to achieve a goal, and because a design is never completely finished, every implementation provides a prototype that can answer questions about whether the goal has been achieved (Easterday et al., 2014).*

The research tools employed in the empirical DBR were mixed, resulting in both quantitative and qualitative data. The empirical investigation consisted of four iterative cycles in 2017 (Chapter 7). The first cycle was implemented in February 2017 and these procedures were followed:

1. The intervention: all the participating students took part in the design skill set intervention. The intervention consisted of two, 40-minute design lectures.
2. Post-intervention Design Assignment: each student was given a design problem, a task sheet containing general instructions as well as an assortment of graphic material to be used as potential sources for analogy.
3. Reflection: evaluating the success of the intervention in terms of the enhancement of the students' design skill sets. This was done by assessing the effectiveness of the design skill set enhancement framework as pedagogy within the existing curriculum for the Foundation Programme. This was informed by a participative generative data methodology where each student drew and discussed a design reflection path followed by an unstructured interview. The student's voice was recorded while they presented and discussed their design reflection path. This reflection exercise leaded to applicable amendments to the intervention and pedagogy.

1.5.4 Phase 4: Reflection to produce design principles

BUILD: *providing feedback about the success of the design and the validity of the theoretical propositions. Indicating whether the design has achieved its practical and theoretical goals.*

After the intervention was implemented, evaluated and refined in the iterative cycles, design principles were developed (Chapter 9). This enabled the researcher to do the following:

a) explore and analyse the problem of design skill sets of foundation programme students;
b) compare the performance of the students in the pre-test and post-test;
c) ascertain whether the improvement in performance in the post-test done by the students demonstrated a measure of improvement. This could be an indication that the intervention was effective in enhancing the development of the design skills set of the foundation programme students.

The classroom observation and the meetings with the lecturers were written up in the form of field notes. The design exercises were photocopied and retained as data sources. Table 1.1 below explains the different data sources that were utilised to achieve the research objectives.

Table 1.1: Research objectives

Research objective	Data source
To investigate the required design skill sets for undergraduate design studies and more specifically design skill sets for Landscape Architecture studies nationally and internationally.	Comprehensive literature review on international and national research on design skill sets for undergraduate design studies, and more specifically for Landscape Architecture design skill sets.
To analyse the design skill sets of students registering for the Foundation Programme and Diploma in Landscape Architecture at the Cape Peninsula University of Technology (CPUT)	MIDAS questionnaire as pre-intervention measure.
To develop a framework to enhance the design skill sets of Landscape Architecture students	Use the Multiple Intelligence (MI) model as theoretical framework to map and analyse design skill sets and apply the design skill set framework. The Framework consisted of two components, the design knowledge semiotic process (DKSP) and the design skill set modal agencies as the tools to enhance the identified design skill sets. Data from all four iterative cycles were used. This data consisted of the design assignment artefacts, the Participative and Action Learning (PAL) projects diagrams, video recordings, and the unstructured small group interviews.
To evaluate the effectiveness of the framework in enhancing the design skill sets of students completing the Foundation Programme into a diploma in Landscape Architecture at CPUT.	A rigorous in-depth interpretation of the data, and more specifically the data of three randomly selected participants. Delving deeper into the design skill set heuristics that emanated from the multiple intelligence conjecture-driven teaching experiment.

1.6 **Structure of the study**

This study is organised into nine chapters that correspond with the DBR process (see Figure 1.2). Chapter 1 provides a brief overview and identifies the research problem and purpose. In Chapter 2, the theoretical underpinnings framing the study are described, and a comprehensive discussion of design education research, as well as a deliberation on Design skills and Multiple Intelligences in the content areas, in particular, is presented. Chapter 3 describes the broader context wherein the study is situated. Chapter 5 outlines the context specific challenges that both Landscape Architecture educators and Landscape Architecture students at CPUT faced relating to design education and its teaching and learning processes. These four chapters represent Phase 1 of the DBR process of analysing a practical problem, informed by both theory and practice.

In Chapter 4, the research design and methodology are discussed in detail. DBR as a design approach is defined and the specifics of all the data-collection methods, as well as the unique research conditions and sample features, are explained.

Intervention research in design skill set development is the focus of Chapter 6 and the motivation behind both the Design Knowledge Semiotic Process (DKSP) and the Design skill set Modal Agencies as learning tools were presented. In this second phase of the DBR cycle, the development of the design solution (Design skill set intervention) within a theoretical framework is outlined.

Chapters 7 and 8 coincide with Phase 3 of the DBR process, namely the implementing and testing of the intervention. In Chapter 7, the findings are reported and in Chapter 8 provides a rigorous in-depth interpretation of the data, and more specifically the data of three randomly selected participants.

Phase 4 of the DBR approach requires the presentation of guiding principles and the dissemination of the findings for gain in both theoretical and practical settings, as proposed by Reeves and others (2005). This important stage in the research process is attained in Chapter 9, offering a reflection on the findings and a set of design guidelines. Limitations of the present study and future research possibilities are discussed.

Chapter 2 :

A MULTIPLE INTELLIGENCE PERSPECTIVE ON DESIGN EDUCATION

2

"I believe, to my core, that everybody has the potential to be creative – whatever form that creativity takes— and that to encourage such development is a noble thing "

Edwin Catmull co-founder of Pixar Animation Studios and president of Pixar Animation and Disney Animation (Catmull & Wallace, 2014)

2.1 Introduction

Sir Ken Robinson (2011) states that the very future of our civilization hinges upon the creative capabilities of young people and that one of the most important things we can do is to foster creativity. With this need to support student creativity, there is a need to assess how learning environments can help educators achieve this goal. Producing creative knowledge, therefore, is a natural response to the immediate environment that we encounter. Following Gardener's (1993) notion of Multiple Intelligences (MI), this chapter outlines the literature that has been reviewed in developing a conceptual framework for this study.

To gather information, to study and make sense of it is a way to solve daily challenges (Botes & Khan, 2017). As a DBR study, the literature review process (part of Phase 1) is critical in conceptualising the fundamental purpose of the study (Figure 2.1). Figure 1.2 positions this critical first phase within the research process of the present study. Herrington, McKenney, Reeves and Oliver (2007) state that the literature review does not only perform the usual research functions, but in design-based studies - along with thorough collaboration with practitioners - it also facilitates the creation of draft design principles (guidelines) (Chapter 6). These design principles inform the design and development of the intervention that seeks to address the identified problem (Chapter 1).

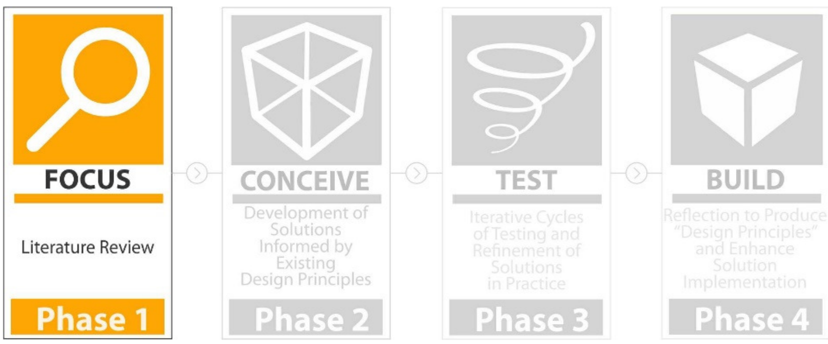

Figure 2.1: Literature review - positioning Phase 1

2.2 Re-thinking creativity and the development thereof

As humanity is evolving and the world population is increasing ever more rapidly, the number and complexity of problems globally are growing and problem solvers with expertise to help us improve our living environment and solve the problems that we are facing, are urgently needed. As Dietrich and Kanso (2010:22) put it: "All progress and innovation depend on our ability to change existing thinking patterns, break with the present, and build something new". However, only expanding our knowledge base might not be enough to solve the predicament we are in. We also need to focus on the combination and manipulation of information and knowledge, as well as how we combine and manipulate it to solve problems (Lawson, 2005). This 'ability' to combine and manipulate information and knowledge is often referred to as creativity, being associated with the process of creating generating novel, useful and appropriate ideas (Dennis & Stella, 2011; Lin, 2011; Kaufmann, 2003; Runco, 2004). It seems to be a matter of the time we live in that creativity is becoming more and more important, not only in its classic field like the arts, but also in scientific, technological and economic contexts as well as in everyday life (Jauk, Benedek & Neubauer, 2012; McWilliam & Haukka, 2008).

The perception of creativity as the original product of an individual is a predominantly Western one (Batey & Furnham, 2016). Creativity is often thought of as though only special people are creative: that creativity is a rare talent, partly genetically determined property of individuals. This idea is reinforced by histories of creative icons like Martha Graham (1894–1991), Pablo Picasso (1881–1973), Albert Einstein (1879– 1955) and Thomas Edison (1847–1931) (Robinson, 2011). While earlier perspectives considered creativity as something dark and mysterious, it is currently regarded as a common cognitive process with relevance to many areas of everyday life (Dietrich & Kanso, 2010). According to Fürst and Grin (2018), creativity researchers have typically distinguished between small-c or everyday creativity (creative hobbies, problem-solving in leisure or work activities) and Big-C or eminent creativity (high-level creativity with major impact on culture). Beghetto and Kaufman (2007; 2009) propose a finer distinction of creativity in four levels: mini-c, which represents simple combinations of basic pieces of information, involved for instance in learning; little-c (or small-c), which is equivalent to everyday creativity; Pro-C, which refers to progression beyond little-c, found in professional-level creative activities (e.g. typically art and science, but in any other domain as well); and Big-C, which is equivalent to eminent creativity (national and international level creativity). The four C-model thus acknowledges everybody's potential to be creative, but also offers a developmental trajectory of creativity in the classroom in which mini-c creativity serves as the genesis of later levels of creative expression (Bereczki & Kárpáti, 2018). In this study, the focus was on little-c and, to some extent, Pro-c. The concept of creativity, as argued by Banaji and Burn (2007), consists of an extensive range of opposing descriptions and definitions. The question can be posed whether creativity is generally understood as an internal cognitive function or an external cultural phenomenon. Banaji and others (2007:15) refer to the reigning binary viewpoints of creativity:

> Creativity itself has been subject to a range of competing definitions in recent years. Such definitions are, however, insufficiently precise to avoid familiar binary oppositions and contradictions in this area which construct creativity as, respectively, elite or democratic; originating from nothing or generic and transformative; spontaneous or taught and learned; universal or culture specific; imaginative and intuitive or knowledge and skills-based; ineffable and instinctive or quantifiable and testable.

Rather than to define creativity or to understand the origin of thereof - due to the multitude of perspectives on it - for the purpose of this study, the focus is on the fundamental aspects of human creativity and how it can be influenced by education. In agreement, McWilliam (2009) sees creativity as a key learning outcome and, through her research, demonstrates creativity as a learnable set of dispositions and capabilities.

Contrary to this, the analytical psychologist Carl G Jung (Chen & Ling, 2010) was of the opinion that the core values or fundamental aspects of creativity, in every field of design, cannot be taught. The only things students can learn are practical techniques. He argued that true creativity must be inspired instead of instructed. Brodbeck & Polanyi (1960) and Blum (2010) agreed with Jung that artistic creativity is not something to be learned and only techniques or 'tacit knowledge' can be transferred from educators to pupils. However, Malaga (2000) challenged this view by claiming that creative ability is influenced by many factors such as: biology, personality, motivation, environment, self-efficacy and training. Oxman (2004) supported this view by arguing that nearly all children are born with a creative ability, but this ability may be lost if not enhanced. This was highlighted by Robertson (2011:15): "everyone has huge creative capacities as a natural result of being a human being. The challenge is to develop them. A culture of creativity has to involve everybody, not just a select few." Thus, this view, in opposition to the views of Carl G Jung and other researchers, sees children as born with a creative ability and that ability is a skill that can be learned and taught. The question of how that creative ability can be enhanced, or how one can be taught to be creative, has been a challenge in design education (Casakin & Goldschmidt, 1999; Celik, 2014; Çubukcu & Dündar, 2008; Lawson, 2005; Catmull & Wallace, 2014). Therefore, the fostering of creative ability in a teaching and learning environment, according to Lin, Kin, Michael, Wong and Siu (2012), can be understood as the confluence of three elements in the framework of creative pedagogy: teaching for creativity, which refers to identifying and encouraging student creativity and providing students opportunities to be creative (Jeffrey & Craft, 2004); teaching creatively, that is using imaginative approaches to make learning more interesting and effective (Bereczki & Kárpáti, 2018), and learning creatively (Craft, Chappell & Twining, 2008), which denotes learning that stimulates creativity.

Consequently, given the perceived importance of creativity for the future workforce, according to the World Economic Forum's Report (2016), the matter of how to embed and develop a culture of creativity is becoming more urgent in education, and particularly in higher education (Dawson, McWilliam & Tan, 2011, Frick, 2011). However, according to Robinson (2011), current approaches to education and training are engulfed by assumptions about intelligence and creativity that have squandered the talents and stifled the creative confidence of people.

Spearman (1928) introduced the concept that creative ability is also a trademark of intelligence. Literature has reported a positive relationship between intelligence and creativity (Batey & Furnham, 2016; Kim, Cramond & Van Tassel-Baska, 2012). Intelligence and creativity, according to Benedek, Jauk, Sommer, Arendasy and Neubauer (2014), are known to be correlated constructs, suggesting that they share a common cognitive basis. Nickerson (1999) provides a balanced view – intelligence is necessary for creativity, but not a sufficient condition in itself. Creativity is inseparable from intellectual ability, which MacKinnon (1970) describes as a reconciliation of expert knowledge and a childlike perception of fresh ideas.

However, the two most prominent trademark features of creative intelligent behaviour is that firstly, the intelligent solution must have some novelty, not just merely reproducing what already exists, and secondly, the intelligent solution must be in some degree successful (Gregory, 1981; Runco & Chand, 1995). This conceptualization focuses on creativity as a cognitive ability or potential (Benedek *et al.*, 2014), but it does not imply other conceptualizations conceiving creativity as personality trait or equating it with actual creative activities or achievements. The work of Steinberg (1985) and more recently Gardner and Steinberg (1994), indicate creative ability as a basic dimension in the intelligence domain. Gardner (2011) further believe that, as long as a culture values an ability to solve a problem or create a product in a particular way, that creative ability should strongly be considered as an intelligence. For the purpose of this thesis, creativity (and more specifically creative ability) was seen as a combination of multiple factors and through the theoretical perspective of Multiple Intelligence theory, the components of these factors were evaluated.

In his book "Out of Our Minds", Robinson (2011:17) remembers these words of Abraham Lincoln, spoken to congress in 1862:

> The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty. As our case is new, so we must think anew and act anew. We must disenthrall ourselves and then we shall save our country.

What he meant was that we all live our lives guided by ideas to which we are devoted, but which may no longer be true or relevant. We are hypnotised or enthralled by them. To move forward we have to shake free of them. Given the challenges in design education, the most profound shift has to be in how we think about creative abilities and the development of these abilities.

2.3 **Multiple Intelligence Theory**

2.3.1 Theoretical background

The concept of intelligence as a general and measurable ability was introduced in 1870 with the publication of Harris and Galton's book, Hereditary Genius (Galton, 1870). Galton further elaborates that intelligence has inherently determined limitations and differs markedly from one individual to another. In the early 1900's the French psychologist, Alfred Binet, designed the precursor to the current intelligence test to identify school children in need of special educational interventions. Binet's scale, along with the contemporary work of Charles Spearman (1928) on general intelligence, served as the original catalyst of all forms of intellectual activity (Perkins, Tishman & Jay, 1993). Spearman's theory of general intelligence remains, within academic psychology, the predominant conception of intelligence (Perkins *et al*., 1993) and the basis for more than 70 IQ tests currently (Gardner & Moran, 2006).

During the latter part of the twentieth century, constructs of intelligence became more complex (Hanafin, 2014). There was a move away from the understanding of intelligence as a unitary, inherent capacity measured by IQ tests. One of these theories that moved away from the IQ-dominated constructs of intelligences was Howard Gardner's theory of Multiple Intelligences (MI). Gardner (1989) also challenged Spearman's (1928) theories of general intelligences, but contributed to the conception that intelligence can be seen as pluralistic. Gardner's theory of MI is the best known of these theories and is greatly supported by the educational community (Newcombe & Frick, 2010; Shearer, 2012; D'souza, Yoon & Islam, 2011; Andronic & Andronic, 2016; D'souza, 2007; D'souza & Chandrasekhara, 2014).

The theory of multiple intelligences (MI), developed by the psychologist Howard Gardner in the late 1970's and early 1980's, was a direct challenge to the classical view of intelligence (Gardner, 1993). Gardner (1993:15) defines intelligence as the ability to solve problems or create products that are of relevance in a particular cultural setting or community:

> The problem-solving skill allows one to approach a situation in which a goal is to be obtained and to locate the appropriate route to that goal. The creation of a cultural product is crucial to such functions as capturing and transmitting knowledge or expressing one's views or feelings.

Gardner and others (1996) add that intelligence is not a 'thing', but must rather be seen as 'potential or 'presence' that allows an individual access to ways of thinking appropriate to specific kinds of content.

The origin of intelligence concept can be seen as a second distinction between MI theory and classical psychological theory. While some contemporary theorists endorse the notion that intelligence can be influenced by environmental factors (Perkins, Tishman & Jay, 1993; Neisser, Boodoo, Bouchard, Boykin, Ceci, Loehlin & Sternberg, 1996), most theorists conceive intelligence as an innate trait with which one is born and which one can change minimally (Herrnstein & Murray, 1994; Jensen, 1993). In contrast, MI theory views intelligence as a combination of inherited potentials and skills that can be developed in diverse ways through relevant experiences (Gardner *et al.*, 1996). For example, one individual might be born with a high intellectual potential in the spatial sphere that allows him or her to master the concepts of design with relative ease but for another, achieving similar expertise in the domain of design requires many hours of study and practise. Both individuals are capable of becoming good designers, in other words experts, in a domain that draws on their spatial intelligence, but the pathways they travel in order to become good designers may differ quantitatively (i.e. speed) and qualitatively (i.e. process) (Shearer & Karanian, 2017).

Stanciu and others (2011) consequently argue that we can accept that an individual is born with a set of genetically predisposed skills which can be developed later in life, depending on social and educational influences. To put it in the context of MI, the individual is born with a starting 'profile' or with a certain level of development of these intelligences, while various experiences like social and educational experiences will determine which and how much of these intelligences will be developed further (Stanciu *et al.*, 2011; Goodnough, 2001).

MI theory had also been criticised on the following grounds: the arbitrary nature of the intelligence categories (White, 2004), not offering a clear programme for educators to use in implementing MI theory (Levin, 1994), and the lack of sound science underpinning it (Waterhouse, 2006).

2.3.2 The Multiple Intelligences

Gardner (1993) proposed that an individual possesses eight relatively autonomous intelligence domains. Table 2.1 indicate the eight intelligence domains and its associated abilities (Jung &

Chang, 2017). Individuals can use these intelligences, individually or combinations thereof, in the ways they take in information, retain and manipulate that information and demonstrate their understanding of it to themselves and others (Gardner, 1983, 1993, 1999, 2006). The eight intelligences are logical-mathematical intelligence, spatial intelligence, linguistic intelligence, musical intelligence, kinesthetic intelligence, interpersonal intelligence, intrapersonal intelligence and naturalistic intelligence (Gardner, 1993).

Table 2.1: Abilities associated with each type of intelligence

Intelligence Domain	**Subdomain**	**Intellectual Aspect**	**Functional Aspect**
Linguistic/verbal	Speaking	Recognizing grammar and vocabulary	Ability to speak persuasively
	Writing	Constructing logical contexts in writing	Ability to use tools necessary for writing
	Reading	Comprehending the logical flow of a text	Ability to understand the mood of a text
	Listening	Recognizing the elements necessary for listening	Ability to follow logically; integration with prior knowledge
Musical/rhythmic	Singing	Recognizing sound elements (melody, pitch, rhythm, etc.)	Ability to use the elements necessary for singing
	Performance	Recognizing instrumental elements and notation	Ability to use instruments to produce harmonious sound
	Composition	Recognizing the principles of composition	Ability to combine musical elements to produce music
	Appreciation	Recognizing musical genres and contents	Ability to select pieces by mood and interpret them
Logical/ mathematical	Number calculation	Understanding the concepts of number and code	Ability to perform all types of calculation
	Logical thinking	Recognizing cause-effect relationships	Ability to classify, and reason
	Hypothesis validation	Understanding statements or theorems	Ability to reason logically from hypothesis to solution
Spatial/visual	Spatial perception	Recognizing spatial elements (depth, length, direction, etc.)	Ability to efficiently express spatial relations
	2D perception	Recognizing various spatial elements in flat artefacts	Ability to express spatial relations on a flat surface
	3D perception	Recognizing the elements composing space	Ability to construct 3D expression
Kinesthetic	Physical exercise	Recognizing the elements necessary for exercise (strength, rhythm, speed)	Ability to apply necessary elements when performing required movements
	Physical work	Recognizing manual functions and their uses	Ability to use tools to produce required objects
	Physical expression	Recognizing various symbols in physical movements	Ability to use the body for expression
Intrapersonal	Affective perception	Perception of one's emotions	Ability to control one's emotions
	Recognition of ability	Perception of one's abilities and skills	Ability to use and develop own abilities and skills
	Future plan	Perception of one's future issues	Ability to envisage the future in behaviours and attitude

Intelligence Domain	Subdomain	Intellectual Aspect	Functional Aspect
Interpersonal	Person-related	Perceiving others by look, voice, disposition, emotion	Ability to understand others and interact with them properly
	Group-related	Perceiving the characteristics of groups	Ability to solve a group's problems; group leadership
Naturalistic	Relationship with the natural world	Sensitivity to natural features, topography and materials	Ability to visualise and experiencing nature and natural phenomena

Source: Adapted from Jung & Chang, 2017

The pluralistic description of these intelligences indicates that individuals possess a combination of intelligences varying in levels of strengths and weakness; this variation does not mean that every individual will necessarily demonstrate a higher aptitude in one or more intelligences (Gardner, 1993; Shearer & Karanian, 2017). The combination of intelligences and mastery of specific domains or semiotic modes (drawing, singing etc.) can be attributed to the mastery of specific forms of intelligences (such as kinesthetic skill, spatial skill etc.). Identifying and recognizing these combinations of intelligences allows for a growing sense of value, nurturing a diversity of creative thought and empathy with the variations of individual strengths (Gardner, 1993; Stein, 2004). To put it in another way, Botes and others (2017:199), describe these intelligences as "abilities to cope with and operate in", and posit them as "domains of engagement". That is, people have individual ways of perceiving objects, accumulating knowledge and experience, memorizing and learning (Jung & Chang, 2017; Peterlin, Dimovski, Uhan & Penger, 2015).

2.3.3 MI theory and its implications for teaching and learning

The re-evaluation of intelligence as a construct of educational psychology, as well as the establishment of various paradigmatic positions, was made possible by the latest development in educational sciences. Gardner's (1999:33) definition of intelligence as the "psychobiological potential to process information that can be activated in a cultural setting to solve problems or create products that are valued within that culture" acknowledges that all intelligence: "is activated based on the given values of a determined culture, the opportunities available in that culture and the decisions taken by each person, family or teachers, and others" (Diaz, 2017:69). Now, as far as education is concerned, an emphasis has been placed on the benefits of the same regarding the strengthening of teaching-learning processes, promoting a diversity-centred approach, improvement of school-family-community interactions, and inspiration for the creation of effective instruments, projects and experiences (Diaz, 2017; Momnenic, Borovnjak, Filek & Velinovski, 2016; Mosely, Wright & Wrigley, 2018). Armstrong (1994:122) states that the theory of multiple intelligences requires generating a fundamental shift in the way teaching and learning are structured: "During a typical school day, every student must be exposed to courses, projects or programmes that focus on the development of their intelligences and not just in standard verbal and logical skills that for decades have been exalted".

Traditionally, the educational system focused on only two intelligences, linguistic and logical mathematical (Gardner, 2011; Goodnough, 2001). Only these two intelligences were valued and tested. Individuals who were weak in either of these intelligences were usually disadvantaged by the teaching and learning process (Sorin-Avram, 2015; Hanafin, 2014). Education, and more specifically design education, must be made more effective and relevant for a large and necessarily more diverse component of the population. Akkuzu and others (2011) suggest that education must be reformed and restructured in terms of educational contents, teaching tools and measures in order to adapt to the need of versatile and innovative abilities in the era of knowledge.

MI theory offers a richly diversified way of understanding and categorizing human cognitive abilities and combinations of abilities, highlighting our awareness of what makes learning possible for individual students. Haley (2004) describes MI theory as a powerful catalyst in education, revitalizing the search for more authentic, student-centered approaches to curriculum, instruction and assessment. From these perspectives, MI theory can be used to match teaching to how students learn, to encourage students to stretch their abilities to develop all their intelligences and to honour and celebrate diversity. Stanciu and others (2011) endorse this perspective and states that a holistic approach to learning needs should be considered and, according to Akkuzu and others (2011), a global perspective on the teaching and learning processes and a focus on differentiated instruction should be promoted.

Akkuzu and others (2011) also points out that we must not only acknowledge a student's individual difference as an important role in the teaching and learning process, but also that instructional methods need to be varied so that students could use their intellectual strengths to better understand topics. This will also increase their intrinsic motivation and encourage active student engagement. Implementing MI theory in teaching and learning does not only help students to learn effectively, but can also affect the students' behaviour. Al-Kalbani and Al-Wahaibi (2015) concluded in their research that, to acknowledge students' individual differences and by recognizing their needs cause students to be more involved, which at the end make them less frustrated and confused. Gardner (2016:50) provides this vision within his theory: "If you want to teach something that's important, there's more than one way to teach it. Multiple intelligences can be useful as an inventory". Thus, MI theory not only acknowledges a student's individual differences, but use these differences to encourage and facilitate learning.

Much of the early work on MI theory in teaching and learning, according to Hanafin (2014), was concerned with teaching to, for and through the different types of intelligences (Armstrong, 1994; Campbell, 1994). This approach entailed the development and use of teaching and learning strategies which focused on various intelligences in order to utilize students' strengths as well as to develop, through exposure, areas of relative weakness (Hanafin, 2014). The concept of teaching through the multiple intelligences constituted that teaching and learning is deliberately structured to include methods which rely on movement, visual-spatial activity, group-work and reflection as well as on linguistic and logical activities, creating comfort zones for all students so that learning could occur with greater ease. On the other hand, teaching to (or teaching for) intelligence exposed the students to stimuli in areas not usually applied in their classrooms. This was intended to develop those intelligence areas in which they are not strong (Hanafin, 2014).

MI theory, among other things, is defined as an educational tool rather than a goal in itself, and has to do with what 'good educators' have always done in their teaching, which is to go beyond the text and the board to awaken the minds of his students (Armstrong, 2009). To do so, MI theory promotes the use of different materials, different methodologies and flexible educational models (Gardner, 2016; Diaz, 2017). Diaz (2017:16) further highlights that: "the curriculum should be organized conceptually, providing an integrated education from prior knowledge of the needs and interests of students and their strong intelligences".

It does not imply that educators need to design eight (referring to MI's eight intelligences) different educational programmes for each class, based on each form of intelligence, or to increase the contents of the curriculum indefinitely. On the contrary, it claims that those elements that are truly significant and that are addressed from different points of view are selected. The interest is always the depth against the extension, and understanding over mechanic memorization (Diaz-Posada *et al.*, 2017; Momnenic *et al.*, 2016; Jensen, 2008)

Hence, teaching and learning must be facilitated in a context that is authentic and relevant, organizing the learning in a sequence that shifts gradually from the concrete to the abstract, adjusting the learning for various abilities, considering the intelligence styles, integrating the outdoor environment as an integral and central component of the learning process, and focusing on both cognitive and emotional aspects of learning (Gardner, 2016). Cope and Kalantzis (2000) remarked that, if the pedagogical outcomes are a developed skill set, then engagement in a community of learners engaged in authentic versions of such practice is necessary.

In the South African context, especially with the disparity that exists in basic education and the diversity of cultures and social contexts, design students should be encouraged to approach resources with their own personal experiences as the starting point before they attempt to make meaning or participate in the discourses of the discipline (Botes & Khan, 2017). Only once they understand their own perspective can students be persuaded to interpret the contextual background and values that inform the social practices and related knowledge that they find in the provided curricular resources. With further encouragement, students will then succeed to construct their own practices, based on new knowledge that is positioned in the same or new contexts.

2.3.4 The relationship between multiple intelligences, domains and skills

The distinction between intelligence and skills is a common source of confusion. Gardner (2006) defines skills as cognitive performance which manifest as a product that resulted from the operation of one or more intelligences. Within and across cultures, the types of skills displayed by individuals vary widely, from picture drawing to surfing, from writing poems to navigating big construction projects (Gardner & Hatch, 1989). Thus, whether an individual's kinesthetic and spatial intelligences are put to use in surfing or marine navigation depends on an individual's access to a body of water, a willing instructor, and time for practice. Living in a culture that values the ability to surf or sail (or dive or catch fish) is another influential factor.

Gardner (2006) posits that skills can be clustered according to the domain in which they operate. A domain is any type of organised activity in a society in which individuals demonstrate varying levels of expertise and is thus applicable to a profession, discipline or craft (Gardner & Moran, 2006). A domain is thus a social construct that exists outside the individual in society and can be created by a broad range of occupations such as lawyers, architects, fishermen, dancers or electricians. Skills in that domain can be acquired through various routes. Lawson and Dorst (2009:98) state "acquiring design expertise is influenced by a complex array of factors", which includes skill acquisition, learning declarative knowledge and developing relevant experiences.

In order to enhance those domain specific skills, not only does specialist domain knowledge need to be developed, but so does the ability to integrate domain knowledge with developing domain specific skills (Mosely, Wright & Wrigley, 2018; Christiaans, Vastenhouw & Cross, 1992; Dorst, 2011). Casakin and Van Timmeren (2015) elaborate further that skills development are caused by a combination of domain-general and domain-specific knowledge (as can be seen in Figure 2.2). Domain-general knowledge encompasses knowledge of general problem solving strategies (Dörner, 1997) and general heuristics (Gigerenzer, 2008), including reflecting activities. Domain-specific knowledge, on the other hand, resorts to factual knowledge about content and process (including design methods), as well as design specific skills such as sketching (Casakin & Badke-Schaub, 2015). Gee (2004) further suggests that, when students learn a new skill, they need to practise it over and over in varied contexts in order to make it operate at an almost unconscious routinized level - highlighting Plucker and Beghetto's (2004) notion that creative skills are probably both domain-general and domain-specific, possibly arranged in a hierarchy of micro domains nested in domains grouped within a general thematic area. Some skills and aptitudes are arguably general and relevant to any domains (e.g. openness), whereas others are more useful for certain domains only (e.g. drawing for Landscape Architects). It is also likely that for little-c, domain specificity is rather low, but extremely high for Big-C (Kaufman & Beghetto, 2009; Kaufman, Baer & Cole, 2009).

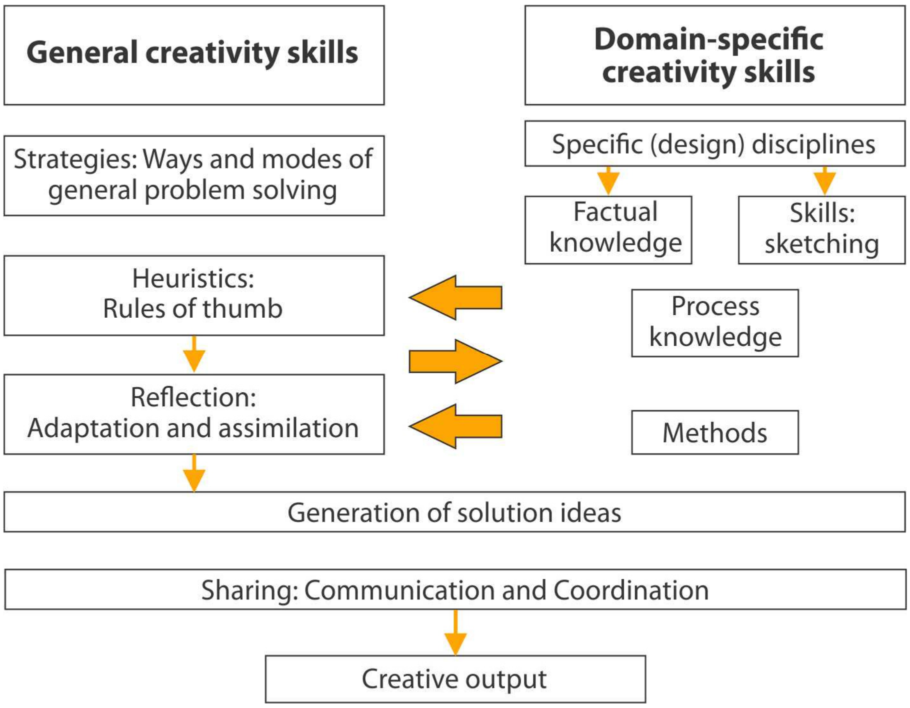

Figure 2.2: A theoretical framework of the determinants of creative ability
Adapted from Casakin & Badke-Schaub, 2015

Originality and appropriateness are also strongly connected to the domain in which creativity manifests, as well as to the knowledge it requires. It has been shown that creativity can manifest in any domain (Baer & Kaufman, 2005), whereas the domain in which creativity manifests provides the knowledge base within which people can be creative (Craft *et al.*, 2008).

Like intelligences, creativity involves solving problems or creating products, but creativity requires doing so in a novel way (Glăveanu, 2018). Yet, novelty in itself does not constitute creativity and a novel product may not necessarily alter a domain. It will take generally ten years or several thousand hours to master a domain and even several more years to alter it (Gardner & Hatch, 1989). Creativity requires concerted focus and dedication to one domain, thus a person rarely achieves high levels of creativity in more than one domain. Moreover, according to Csikszentmihalyi (1996), creativity is a communal measuring tool that is ultimately rendered by the gatekeepers and practitioners of the domain.

Intelligences, in contrast, are used daily across a variety of domains. During one day, a person may use linguistic intelligence to write a letter to a friend, read an article on the environment and question the quality of education in a class debate. In developing one or more intelligences to a high degree, individuals become experts in a domain and are readily recognized as such (Gardner, 1993). Gardner (1993) elaborates further by stating that not all intelligences are required for creativity, but creative dispositions can be found in individuals with specific intelligence profiles. Overall, intelligence can be defined as *"the capacity to solve problems to contrive something to achieve results in a given culture or society"* (Horng, Hong, ChanLin, Chang & Chu, 2005:74). This definition includes efforts to adapt social and cultural values and illustrates the different functions of each intelligence type. The interaction between different intelligences illuminates the various abilities utilised by humans to survive in socio-cultural contexts, such as the tendency to use a variety of intelligences rather than always depending on a specific type.

2.4 **Design skill sets**

Resulting from a survey that was distributed to a broad spectrum of 1343 designers, managers and executives working for both design consulting firms and manufacturers in corporate America, Momnenic and others (2016) suggest that the most important skills needed for design were problem solving, innovation and sketching. Secondary to these were teamwork and verbal skills, followed by computer-aided drafting (CAD), styling, production, anthropometry, marketing, human factors and technical skills. The results of the survey also showed that the respondents from the design industry do not see design education institutions as effective enough in teaching problem solving, innovation and design skills.

2.4.1 Theoretical background

Within design orientated domains, i.e. artists, landscape architects, fashion designers etc., Lawson (2005) hypothesizes that design is a highly complex and sophisticated skill. D'souza (2014) elaborates on this hypothesis that design skills cannot be restricted to a unique skill, but rather a flexible framework that consists of multiple abilities that designers intentionally use to achieve desired goals in specific design scenarios. Thus the designer, within its domain, must become an 'integrator' of various skills and knowledge (Barrow, 2000). It demands that the individual has a wide array of skill sets, for example spatial visualization, logical thinking, emotional reflection, linguistic ability and interpersonal skills (D'souza, 2009).

Alkan (2004) suggests that integrating these skill sets requires that the term 'skills' addresses both mental constructions and external depictions, as design representations often lie in a space where the mental conceptions and its material expression had taken place. Thus, to make the term 'skill' more inclusive, the meaning of the term 'skill' will be used in this thesis as a generic term that overlaps with terms such as aptitude, competency or representation. Spatial skill, for example, could indicate both the visualization of space and the graphical articulation of that space in the form of a sketch (D'souza, 2009). The MI theory was used as an inclusive approach to examine this complexity of design activities.

According to D'souza (2014), identifying the composite of skill sets for designers could firstly contribute to making design learning more inclusive by understanding the differences in skills, weaknesses and strengths; secondly to the recognition of individual differences and approaches in design and, thirdly, could allow for an empirical analysis of the nature of design aptitude. This composite of skill sets for designers will reduce the overt emphasis on graphical skills and form-making with skills such as problem-solving, spatial sensitivity, interpersonal and linguistic skills which will be more critical in dealing with real world design situations.

2.4.2 Required intelligences for design

MI theory, according to D'souza and Chandrasekhara (2014), is based on the assumption that intelligences and the mastery of specific domains (i.e. drawing and dance, etc.) could be linked to the mastery of specific groups of intelligences (i.e. kinesthetic intelligence, spatial intelligences etc.). Shearer (1996) developed the Multiple Intelligence Development Assessment Scale (MIDAS) as a measurable scale for Gardner's intelligences. MIDAS is intended to give a reasonable estimate of the person's intellectual disposition in each of the eight main intelligence areas proposed by Gardner.

Empirical evidence from the studies conducted by Shearer (1997) and D'souza (2007) among college students had identified and validated that claim (Table 2.2). The studies indicated for example that students studying dance scored 64% on kinesthetic intelligence, compared to students in psychology (41%), engineering (44%), and music (45%). It is also important to note that architecture students scored 68% on spatial intelligence; musicians scored 75% on musical intelligence; engineers scored 64% for logical; psychologists scored 65% for interpersonal intelligence; and naturalists scored 82% for naturalistic intelligence (D'souza & Chandrasekhara, 2014).

Table 2.2: Multiple Intelligences consistent with well-defined ability groups

	Intelligences							
Groups	Spatial	Intrapersonal	Interpersonal	Logical	Verbal	Natural	Kinesthetic	Musical
Naturalists	55	62	56	60	59	82	46	44
Music	52	59	54	54	69	43	45	75
Architecture	68	65	58	56	55	54	50	50
Dancers	56	58	63	51	65	54	64	58
Artists	60	56	59	56	60	52	51	55
Engineering	61	63	55	64	55	49	44	47
Psychologists	52	61	65	51	65	52	41	38

Source: Shearer, 1997; D'souza, 2007

Furthermore, D'souza (2007) concluded (as can be deducted from Table 2.2) that the MIDAS scores for architectural students ranged between 68% (spatial) to 50% (kinesthetic and musical). Comparing to other groups, architecture excelled in spatial intelligence but did not lag in other intelligences. The low difference of only 18% between the lowest scale and highest scale demonstrates that architecture students may be good at several different intelligences rather that specialized in only one or two types of intelligence.

Recent research done by Jung and others (2017) emphasises that the development of specific types of intelligence does not necessarily enhance creativity, but rather an 'arrangement' of all of the intelligence components and their interrelationships in order to achieve the proper balance of the different intelligences. It can be concluded that designers used all intelligences in some threshold capacity although they excelled in domain specific intelligences.

2.4.3 Design as a skill set

Cross (1996) states that design knowledge is a 'designerly way of knowing'. With reference to this broad definition of design knowledge, different studies in design elaborate on this 'designerly way of knowing'. For example, authors like Goldschmidt (2002) and Casakin (1999) examined design aptitude, Cross (2011) examined the personality traits of designers, others looked at design process and methods (Cadle, 2009; Lawson, 2004), and some at the nature of design (Celik, 2014; Bashier, 2014; Viljoen & Van Zyl, 2009). Design researchers hence tend to be more comfortable with dimensions of creativity to describe the unique abilities of designers. Creativity is also a favoured term if you assume that the objective of the design process is not simply to produce, but also to produce creatively (Dennis & Stella, 2011).

D'souza and others (2014) hypothesise that the design process could be solved in a variety of ways. One way is using the dual nature of design, especially in terms of rationality and skill based processes, and how to essentially co-emerge design and skills in a balanced and integrated manner (Bashier, 2016). The skill-based processes of design will broaden the scope of design skill to a multiple skill set. Identifying and examining these skills are important to understand how designers communicate and propagate ideas in the design process.

To identify these design skills and to provide some coherence between design skills and multiple intelligences, D'souza (2009) suggests organizing design skills into four thematic sets, referred to as design skills sets. The themes include:

- skills that involve emotions (subjective and creative responses to design);
- skills that involve the senses (bodily experience in relation to the design world);
- skills that involve logic (rational and systematic approach to design); and
- ideational/depictive skills (visualization and representation of concepts, ideas and spaces) (D'souza, 2009).

The relationship of these design skill sets with Gardner's multiple intelligences are elaborated upon further below.

2.4.3.1. Skills that involve emotions

How a student feels, can profoundly shape how he or she thinks. For example, emotions can promote learning by capturing and holding attention (Martin & Ochsner, 2016). In recent years, interactional, sociological and cultural dimensions of creativity have been widely explored (Schmoelz, 2018). Some efforts have been made for an integrative approach to creativity that studies the intersection of "individual, collaborative and communal creative activity" and that focuses on the link between what "happens in and between us" (Schmoelz, 2018:2). D'souza (2009) suggests that, when there is insufficient information to make logical judgments, a designer will rely on emotions and instinct. Goldschmidt (2011) confirms this by stating that designers use new and unexpected combinations of existing knowledge, items in memory and new information superimposed on them. Skills that involve emotions are intrapersonal intelligence (personal emotions) and interpersonal intelligence (another's emotions) (Table 2.3).

2.4.3.2. Skills that involve the senses

Designers interact constantly with the environment surrounding them (D'souza *et al.,* 2011). Furthermore, designers' creative self-confidence is influenced by how they perceive their environment to be either restrictive or encouraging. This will influence the individual's potential for creative behaviours and creativity displayed (Lim & Plucker, 2001). Skills that are associated with such external senses include kinesthetic intelligence (visualizing or experiencing the movement of the body in relation with the external environment), and naturalistic intelligence (visualizing and experiencing nature and natural phenomena (D'souza, 2009) (Table 2.3).

2.4.3.3. Logic-based skills

These skills refer to how designers understand and apply abstract symbols/formulae, formal logical thinking, deciphering codes, numerical calculations and problem solving (D'souza, 2009). The design process is a problem-solving process that involves creating innovative solutions (Cubukcu & Dündar, 2008). Nazidizaji (2015) adds that design is an open-ended problem solving process and the functions of design skills support designers' cognitive abilities. Skills that involve logic are logical-mathematical intelligence (working with numbers and geometry as well as solving problems), and spatial intelligence (understanding symbols and identifying and designing formal strategies) (Table 2.3).

2.4.3.4. Ideational/depictive skills

Ideational/depictive skills allow for the visualization and representation of concepts, ideas and spaces. This has the strongest connections to design, because they involve both the medium and product of designing (D'souza, 2009). Lawson (2005) observes that there are many types of thinking and concludes that reasoning and imagining are probably the most important to designers. Spatial intelligence includes the ability to perceive the visual world accurately and to transform and modify initial perceptions via mental imagery.

Table 2.3: Design skill sets and attributes

MAIN SKILL-SET	ATTRIBUTES
EMOTIONS	Involving personal experiences and reflection in design. In any design exercise, pure logic doesn't always suffice. A designer who does not have enough information may rely on emotions and instincts.
	Using analogy and metaphor in design. Analogy and metaphor are useful devices in design conceptualizations.
	Pursuing purpose and meaning in design. Designers create not just novel solutions but also meaningful ones, turning design into an act of contemplation.
	Personal knowledge and efficacy. A designer with high personal efficacy not only brings focus to design but knows design issues that need to be explored.
	Social Persuasion. As much as design is concerned with individual expression it is also a part of larger social processes. Design involves action, leadership and diagnosis to solve problems
	Sensitivity to human behaviour and user needs. Understanding user needs, socio-cultural norms and behavioural patterns is vital to creating well-informed design solutions.
SENSES	Sensitivity to body movement in space/orientation. Conceptualizing body movement in space includes visualizing how space unfolds with respect to human movement and exploring space- time relationships.

	Sensitivity to human scale. Human scale determines how space should be modulated, exaggerated or understated. Sensitivity to human scale can be aesthetic or pragmatic in terms of universal design, ergonomics and accessibility.
	Sensitivity to natural features, topography and materials. Some design domains act upon the natural world. A skilful designer must be keenly aware of surrounding landscape, such as trees, water, geological features and movement of the sun, understanding the importance of site history and specificity of a design context.
LOGIC BASED	Sensitivity to the use of numbers or geometry. Numbers and measurements play an important role in design: representations conveying the expressive potential of geometry and rhythm or pragmatic abilities of dimensioning and area estimations
	Producing design variations of formal strategies. There is no single solution in design. Designers produce alternatives from which one can be chosen. To produce alternatives, a designer needs to be both analytical and divergent in thinking and to understand relationships between the whole and parts.
	Identifying and using design precedents. Design precedents are used to incorporate previous ideas in new situations. The vital part is the ability to understand what fits a problem and what does not. Identifying and using appropriate precedents is a device that reduces time and resources
IDEATIONAL/DEPICTIVE	Spatial choreography. Spatial choreography involves physical placement of space in a way that conveys mood and ambience of the context.
	Sensitivity to spatial transparency, enclosure and the play of light. Transparency in architecture can be achieved through sensitivity to texture, visual weight and material density, not physical characteristics of materials alone
	Sensitivity to spatial transition. Spatial strategies need not be focused just on major spaces as objects but also on transition zones, i.e. from private to public, large to small etc.
	Clarity in spatial organisation. Clarity in spatial organisation leads to better design communication and visualisation of different systems.
	Thinking in different scales in space. A designer must handle macro and micro scales of information, assimilating design ideas at differing scales
	Aesthetic cognition. Aesthetic cognition is both logical and sensory, evoking craftsmanship and sculptural qualities of design
	Articulating design ideas. A designer with good verbal ability uses words with elegance and parsimony.
	Using verbal tools such as riddles, quotes and narratives in design. Design can be used as an analogy to the act of language narration.

Source: D'souza, 2009

Recognizing design in general as a multiple skill set, has several benefits. It not only recognizes that there are individual differences, representations and approaches in design, but also removes the overt emphasis on limited skill sets that are explicitly taught to more tacit skill sets such as communication, interpersonal and situational problem-solving skills.

Thinking of design as a domain which consists of interplay of various intelligences may be more plausible than thinking of design as a separate form of intelligence. Hence, design intelligence cannot be restricted to one set of variables, but should rather be considered as a flexible framework consisting of multiple intelligences that can be adapted to produce desired outcomes.

Therefore, a holistic approach to learning could be considered. A global perspective on the teaching-learning processes and a focus on differentiated instruction should be promoted, with a clear view on maximizing the learning in every student. Thus, multiple intelligences theory becomes the foundation for an efficient achievement of educational objectives by means of socio-pedagogical factors.

2.5 Conclusion

The objective of a literature review "is to provide a critical overview of existing knowledge of the main issues related to the study topic" (Joseph, 2004:34). This chapter realized objective 1: To investigate the required design skill sets for undergraduate design studies and more specifically design skill sets for Landscape Architecture studies nationally and internationally (section 1.3).

Chapter 3 will position the study within the context of design education and more specifically Landscape Architectural education.

Chapter 3 :
POSITIONING THE STUDY

"The strength of… (education) is its ability to challenge its own truths by presenting alternative possibilities. That forces you to justify your own ideas, and that competition of ideas is what creates excellence"
(Friedman, 2001:4)

3.1 Introduction

Research objective 1, to investigate the required design skill sets for undergraduate design studies and more specifically design skill sets for Landscape Architecture studies nationally and internationally (section 1.3), was realized in the previous chapter. This chapter describes the context in which the research is situated. As a DBR study, the contextualisation process (part of Phase 1) is critical in conceptualising the fundamental purpose of the study and should, according to Herrington and others (2007) address complex problems in real world contexts. Figure 3.1 illustrates the positioning of Chapter 3 in Phase 1 of the DBR process.

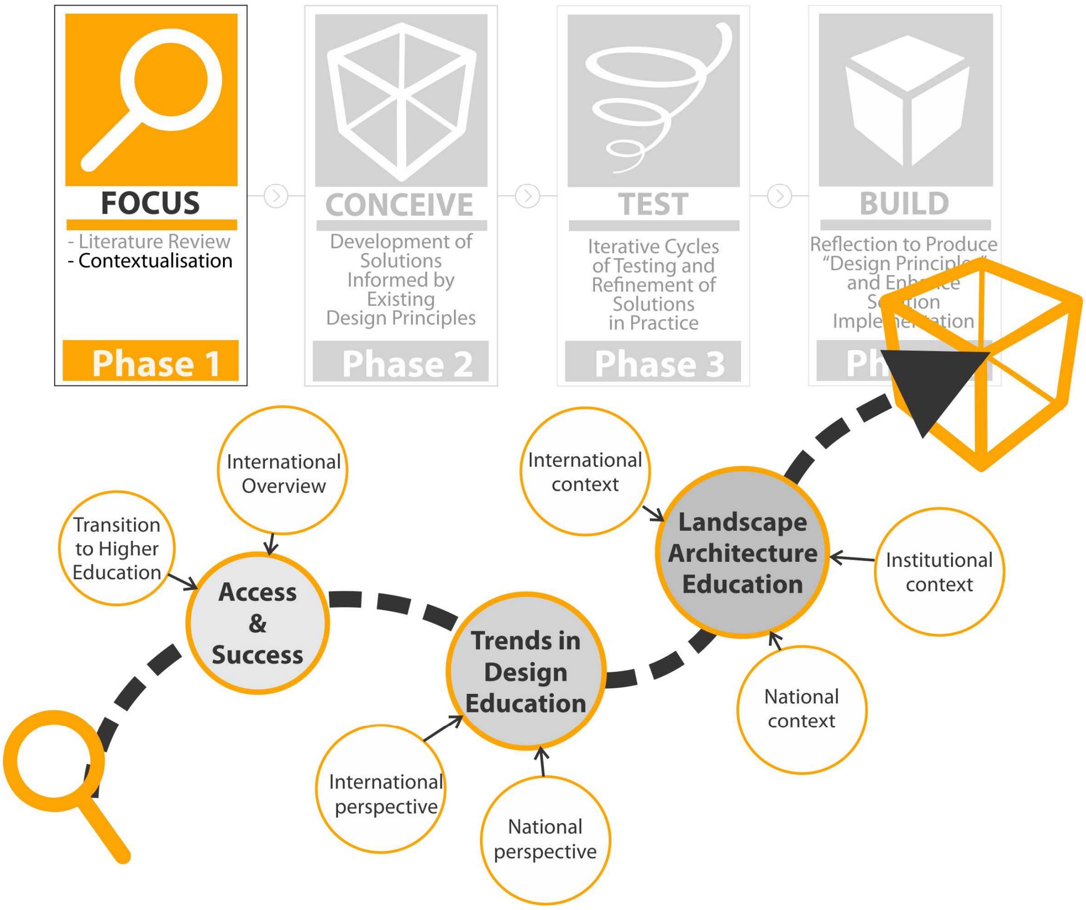

Figure 3.1: Research contextualisation process- positioning Phase 1

The contextualisation process firstly creates a brief overview of access and success in higher education, and more specifically the transition from school to higher education, and highlights some international imperatives of access and success in higher education (see section 3.2 and 3.3 for more detail). Secondly, it explores the wider context of design education internationally and nationally, accentuating current trends in design education (as described in section 3.4). Lastly, it focusses on the specific discipline of Landscape Architecture in design education (section 3.5). This chapter starts from a wide international Landscape Architecture education context, then moves to a national context perspective, and ends with the institutional context relating to the study.

3.2 Transitioning from school to higher education

The transition process into higher education, referred to by - amongst others - Botes and others (2017), places the new first year student in a vulnerable position. The relocation of a student from his/her home into an unfamiliar environment and lifestyle is a huge challenge in the absence of social support previously provided by the family and/or familiar social context. This requires adjustment through establishing new friendships and a redefinition of individual identity construction (Wilcox, Winn & Fyvie-Gauld, 2005). Krause and Coates (2008) assert that students who are able to integrate socially adjust more easily, due to the support of their peers. However, social cohesion is negatively affected by the diverse backgrounds of the students. Thus, social integration is affected by socio-economic backgrounds, which in turn affect a student's ability to adapt to higher education (Botes & Khan, 2017). According to Leese (2010), differences in socio-economic status can inhibit social interactions and delay the ability of students from contrasting backgrounds to find social support among peers. Students of diverse backgrounds and those who are of poor socio-economic backgrounds are more vulnerable in the higher educational context (Briggs, Clark & Hall, 2012). The design students from a poor socio-economic background are particularly prone to incompletion of studies due to the unlikelihood of them being exposed to design disciplines, as a result of subject offering limitations in state-resourced schools (Saidi & Nazier, 2011). Briggs and others (2012) state that these difficulties in transition could lead to students deregistering, which is particularly problematic in the case of those students who aspire to transform their socio-economic status through higher education. The role of the educator in addressing the threats of incomplete studies is therefore crucial (Botes & Khan, 2017).

3.3 International imperatives for access and success in Higher Education

An academic revolution has taken place in higher education in the past half century marked by transformations unprecedented in scope and diversity (Altbach, Reisberg & Rumbley, 2009). The value and purpose of higher education have been questioned, specifically in the context of globalisation, the Bologna reforms, massification and expansion (Pires, Rodrigues & Pessoa, 2018). The complexity of the societal transformations has challenged higher education institutions all over the world into changing and reforming to meet a diversity of needs of students, employers and communities (Jongbloed & Vossenstein, 2016). The importance of equal access to higher education was already emphasised in 1948 by UNESCO in article 26 of the Universal Declaration of Human rights, proclaiming: "Everyone has the right to education… higher education shall be equally accessible to all on the basis of merit." (UNESCO, 1948). This notion of the importance of equal access to higher education was echoed in 2008 by a statement from the European Education Ministry (Kelly, 2008a:15) that emphasised the importance of the social dimension of higher education:

> Higher education should play a strong role in fostering social cohesion, reducing inequalities and raising the level of knowledge, skills and competences in society… we share the societal aspiration that the student body entering, participating in and completing higher education at all levels should reflect the diversity of our populations. We reaffirm the importance of students being able to complete their studies without obstacles related to their social and economic background.

Social equity will not be achieved through access to post-school education alone. In order to fully enjoy the benefits of higher education and to contribute to the economy and society in which they live, individuals need to complete their programme of study. True progress depends on high levels of completion for all population groups. Altbach and others (2009) point out that greater participation rates in higher education do not (by themselves) open the same opportunities equally to all. Research has repeatedly shown that disadvantaged populations, once enrolled, are less likely to continue to degree completion (Slabbert, 2015; Bernard, 2015; Cadle, 2009).

Expanded enrolment that encompasses historically under-represented populations presents many new challenges to the institutions enrolling them (Chesters, Rutter, Nelson & Watson, 2018). If the objective of expanded access is for this new cohort to also be academically successful, then new systems for academic support and innovative approaches to pedagogy will be necessary.

Kalin (2012) highlights that knowledge production within higher education has been infiltrated by the market ideals of neoliberalism, systematizing academic work into predictable outcomes that are comparable. Kalin (2012) refers to a 'pedagogical turn' in design education that is symptomatic of these institutional struggles. Design education can be implemented as a form of critique that focuses on the institutionalization of education within the knowledge economy

(Kalin, 2012). According to Orr and Shreeve (2018), there is a growing adoption of creative teaching approaches across a range of university subjects. In universities today there are examples of nursing education drawing on fine art approaches, business students creating artwork, and arts being deployed to enhance clinical practice for medical students (Gustina & Sweet, 2014). This trend is highlighted by a quote from Bert Stabler in Kalin (2012:2): "by remaining at the margins of culture, fine art has … managed to open up possibilities that education has not".

Inferring to the academic revolution in higher education, social transformation and UNESCO's declaration that everyone has the right to education, design education plays a pivotal role of addressing social equity, changing and reforming higher education to meet a diversity of needs of students, employers and communities.

3.4 Trends in Design Education: International and national perspectives

Design is a complex, personal, creative and open-ended skill. Van Dooren, Boshuizen, Van Merriënboer, Asselbergs and Van Dorst (2014) label the design process as 'unstructured'. Lawson (2005) observes it as a 'prescriptive job' creating the future. Schön (1983:34) refers to design as complex: "it is about different kinds of knowledge, about developing a personal system of preferences, and about using a specific language of sketching and modelling". Van Dooren and others (2014) elaborate further that, for experienced designers, the process is not split up in separate steps and actions, but is an undivided whole with automatic, unconscious steps, actions based on common practice or routine, and moments of reflection and exploration.

The challenge is therefore how to facilitate the learning process of students to develop such a complex, personal, creative and open-ended skill like designing (Hargrove & Rice, 2015). The development of creative, innovative and critical abilities highlights a growing pressure which exposes the inadequacy of traditional teaching methods based on teacher-centred lessons (Saliceti, 2015). New teaching methods are required. These teaching methods should address students' needs more effectively and should be characterized by students' active involvement in reflection and developing understanding. This is supported by Pires and others (2018) by referring to the Bologna accord that placed the focus on student-centred learning (students' experiences and interests) and on the outcomes of the learning process (development of competencies and capabilities), rather than the teaching and curricular contents.

This focus on curricular content dates back to Vitruvius's list of 'allied disciplines' that a design student must study and understand. Written during the reign of the Emperor Augustus (27 B.C.- A.D. 14), this course of study is still referred to in many design programmes (Brady, 1984). It includes drawing, geometry, history, philosophy, music and medicine, principles of order, arrangement, eurhythmy, symmetry propriety, economy and art.

Consequently, there exists a lack of cognitive theories that function to strengthen design education and thus the cognitive skill sets required for design are sometimes not adequately developed in design education (Oxman, 2008).

3.4.1 International trends in Design Education

There are differing standpoints with regard to the ways in which knowledge acquisition in professional fields occurs. Symes (1989) observes that many problems in design education stem from the fact that design content is broad and much of it is directed towards practical outcomes, placing emphasis on skills and techniques. This creates tension between descriptive or declarative and prescriptive or procedural knowledge.

One stance regarding how knowledge is acquired, according to Dunin-Woyseth (2007), advocates for an *a priori* acquisition of knowledge as preparation for design education. The design studio as a core design education mode is thus proposed to become a 'capstone' for this education. According to the 'learning by doing' philosophy (Schön, 1983), the design studio is widely recognized as an indispensable component of the design curriculum. In creative and arts-related educational programmes, the studio is a space for experimentation and creative development. It is a physical space, and rather than reading and writing, students perform design enquiries through drawing and modelling. And learning is haptic–kinesthetic and visual–spatial, rather than verbal–linguistic or logical–mathematical (Gardner, 2011). This approach is supported by the view that the design profession has developed into a knowledge intensive field of expertise. This resulted in higher education institutions, including art schools and university campuses, having developed a varied range of studio environments (Marshalsey, 2015). These diverse learning spaces inherently create a complex fabric of affects. The studio has a high degree of specificity regarding the teaching process. Contemporary curricula include a wide range of working methods and directions, resulting in theoretical and physical products, showing the degree of preparation of young designers (Baldea, Maier & Simionescu, 2015).

Yet, the design studio environment has remained the same throughout the past century. According to Cuff (2011), traditional academic design studio pedagogy can be traced back to the ateliers of the nineteenth century famous French design institute, the Ecole des Beaux Arts (1819-1914) and the Bauhaus workshops (1919-1932) in Germany. While studio education has its roots in the master-apprentice traditions of medieval craft guilds, much of the physical process, according to Haase (2006), of 'doing' and in turn 'learning' from the process of real world integration has been lost. As the Studio Culture Task Force of the American Institute of

Architecture Students (AIAS) (Bashier, 2014b) noted, the ongoing changes in design education are not aligned with today's fast changing world, especially in the context of design practice. Additionally, Oxman (2004) refers to the 'Achilles heel' of the traditional studio, that is, that evaluation is based on the final product rather than on a measure of increments of knowledge acquired as a result of the work in the studio.

Researchers, scholars and practitioners are recognising that higher education, and more specifically design education, must encourage authentic, student-learning environments and that there is a responsibility to equip students to cope with global changes and challenges (Machemer & Crawford, 2007; Laurillard, 2012; Lai, 2011). In addition to responsive pedagogical models, emerging technologies have been identified as having potential to offer solutions for some of the problems lately affecting higher education such as greater demand for graduates; increasing costs of higher education and inadequate preparation of students for real-world demands (Machemer & Crawford, 2007; Lai, 201; Yang, 2015; Lombardi, 2007). According to the World Economic Forum's (2016) report, strategy officers from leading global employers stated that, in 2020, over one-third of skills (35%) that are considered important in today's workforce will have changed. The report indicated that, in 2020, complex problem solving, critical thinking and creativity would be the top three skill sets required for the future workforce.

Due to increasing student numbers, student populations in higher education are generally becoming more and more diverse (Boelens, Voet & De Wever, 2018). This trend has sparked an interest in blended learning, an instructional approach that combines online and face-to-face instructional activities to create more flexible modes of education and personalized learning trajectories (Fung, 2017; Hughes, 2018). There are different points of view on how blended learning may contribute to achieving this goal. Traditionally, blended learning has been used to make higher education more accessible to students, as online activities allow students to go through the learning materials when and wherever they want (Norberg, Dziuban & Moskal, 2011). However, more recent conceptualizations of blended learning go beyond this notion of flexibility in terms of time and place. In addition to this increased accessibility, blended learning also offers opportunities to cater for students' individual needs and to achieve real personalized instruction (Watson, 2008; Wanner & Palmer, 2015). For instance, the popular flipped classroom approach to that of blended learning aims to free up classroom time for student questions, in-depth discussion and personal feedback by requiring students to prepare online for learning activities, according to their own levels of understanding (Boelens *et al.*, 2018; Wanner & Palmer, 2015).

During the last decade, emerging technologies have begun to influence central issues in design theory (Oxman, 2008). These developments have notably affected theoretical, conceptual and methodological aspects of design education. Beyond the exploitation of digital media as tools, the relation between digital design and digital design models as a form of design knowledge has begun to emerge as a significant ideational resource for design and design education. Technology, such as computers and different kinds of software, is changing the knowledge that designers need, how they work and what skills they need to acquire (Giloi, 2017). Momnenic and others (2016) suggest that design education has to be reviewed and updated regularly, since new technologies and continuous transformation of the product development process stimulate the development of and changes in the design practice. For example, the results of their study show that 55.1% of job openings request applicants to be proficient in 3D graphic software (Momnenic *et al.*, 2016). It is necessary to emphasise continuous learning of new knowledge and skills for design students in order for them to adapt to these changes (Momnenic *et al.*, 2016). In particular, there should be greater emphasis on the process and regarding the end product as media instead of seeing it as the final purpose.

Traditionally, designers sketch and make physical models (Van Dooren, van Merriënboer, Boshuizen, van Dorst & Asselbergs, 2017). Traditional tools can support creativity during the early stages of design work. For example, Tan, Melles and Lee (2016) investigated how practising graphic designers dealt with broad and ill-defined design challenges, and concluded that the practitioners had a preference for paper and pen to sketch and draw initial ideas. One of the reasons for this approach is that traditional tools support the fast development of many alternative solutions and visual ideas (Stacey, Eckert & Mcfadzean, 1999), as well as better conceptions of the design problem. However, due to the increase of student numbers with varied learning profiles, art and design programmes of study have limited opportunity to use traditional tools for the development of traditional drawing and visualisation skills (Souleles, 2017). Consequently, it is easier to build on the digital skills that these students bring with them to the learning process, than to plan and accommodate an additional unit of study specifically for the development of traditional drawing and visualisation skills. Also of importance is the notion that technology can better support design and development that requires high levels of detail and visualization, or more accurate visual solutions (Bilda, 2001). It is argued that the ability of these tools to facilitate accurate visual detail is an advantage for the latter stages of design work when refined outcomes of high fidelity are required (Machemer & Crawford, 2007; Tan *et al.*, 2016; Chen & Ling, 2010; Bilda, Gero & Purcell, 2006). Souleles (2017) concedes that, in the context of the specific conceptual learning task (a problem-solving activity), it is hard to proclaim that one method is more useful or better, compared to one another, but rather that individual preferences, knowledge, attitudes and contexts determine the choice and usefulness of methods.

The emergence of digital technology has introduced computer labs as the new central learning space for design students (Scott-Webber, Branch, Bartholomew & Nygaard, 2014). Since this change, higher education design institutions have struggled to sustain a vibrant studio culture in the traditional sense. Good pedagogic practice requires that teachers in design education understand the role that the learning space plays in student learning and that learning space should foster an environment where students are encouraged to engage in authentic learning activities. Teaching in different physical learning spaces encourages academics to review current curriculum and their teaching practice to align with the affordances of that learning space, e.g. technology-rich, open spaces being used to facilitate collaborative and blended learning (Scott-Webber *et al.*, 2014). Design educational pedagogies should be directly linked to the professional practices beyond the university and the knowledge, skills, behaviours and understanding that students will need as designers. They help to bridge two worlds or cultures, that of academia and the professions.

3.4.2 National trends in Design Education

Since 1994 the student profile of South African universities has changed dramatically, with increasingly more students enrolling and having a unique set of needs and expectations to be met (Reddy, Baijnath, Brennan, Fourie, Genis, Noruwana, Singh & Webbstock, 2000). This trend is evident, based on research conducted from 2008 to 2009, whereby South African higher education institutions (HEIs) were involved in academic proficiency testing (Agherdien, Mey & Poisat, 2018). Their results indicated that many students entering university did not have the necessary academic skills required to succeed. The findings further showed that 47.6 per cent of students possessed the necessary academic skills; 25.32 per cent had the necessary data interpretation skills; and lastly, only 6.8 per cent had the necessary mathematic ability to meet the requirements (Agherdien *et al.*, 2018). South African students additionally face a number of other challenges, which include the type of schooling, academic proficiency, support and resources, as well as their levels of motivation and integration. Lourens, Fourie and Mdutshekelwa (2014) further elaborate that, even if educationally disadvantaged students gain access to higher education, they still struggle to succeed. According to their research, these struggles can be ascribed to academic, financial, social and administrative challenges (Lourens *et al.*, 2014).

Transformation efforts in South African higher education have been under increased scrutiny in recent years, especially following the last years of student activism and calls for decolonization of universities. The recent South African student protests against university fees (the '#Fees-Must-Fall' movement) have incorporated demands for the 'decolonization' of university curricula. What these demands entail for design disciplines needs clarification, given the European origins of not just design curricula, but virtually the whole tertiary education system.

In an illuminating article examining the decolonization of South African academia, Mbembe (2016:32) ponders the expediency of the notion of decolonization for the reformation of higher education:

> The harder I tried to make sense of the idea of 'decolonization' that has become the rallying cry for those trying to undo the racist legacies of the past, the more I kept asking myself to what extent we might be fighting a complexly mutating entity with concepts inherited from an entirely different age and epoch. Is today's Beast the same as yesterday's or are we confronting an entirely different apparatus, an entirely different rationality – both of which require us to produce radically new concepts?

This understanding of decolonisation shifts the epistemic and philosophical conversation on curriculum reform beyond decolonization towards re-contextualisation of education in South Africa. The focus on research and innovative practice - with respect to teaching and learning and consideration to experiences of historical and continued inequalities - has accelerated over the past few years, with a growing emphasis on teaching and learning that is transformative and that challenges didactic normative methods (Shefer, Strebel, Ngabaza & Clowes, 2018; Carolissen & Bozalek, 2017). There is a substantial body of research exploring different kinds of pedagogical approaches to questions of inequality and diversity; for instance where teachers reflect critically on their own and each other's practice, as well as the extent to which they themselves are implicated in re-inscribing the inequalities they hope to challenge (Garraway, 2017; Hutchings, Garraway & Kioko, 2010; Bozalek, Garraway & McKenna, 2011).

The role of the 'socially orientated' designer remains a pressing topic amongst designers and academics, with several international educational institutions addressing key issues through curricula dealing with topics such as human-centered design, co-design, participatory design, service design, experience-based design, sustainable design, design activism, and design thinking as key strategies for the viability of design products (Cadle & Kuhn, 2013). The manner in which human-centered design is taught at South African institutions, has not yet been properly documented, if at all. In South Africa, human-centered design is taught mostly within the parameters of the user-centeredness contained in architecture, product and interaction design, information technology (IT) and information and communication technologies (ICT) curricula. When included as a component in design programmes, the approaches differ - depending on the historical context of the institution. At traditional universities, entrenched tradition provides opportunity for engagement with the philosophical and theoretical concepts associated with human-centered design. On the other hand, universities of technology (UoTs) have, to a smaller or larger degree, retained some of the legacy of the former technikon education system (possibly, in part, due to admission criteria which are far lower than those of 'traditional' universities) by continuing to focus teaching on skills acquisition and vocational readiness.

Up until 2005, design education in South Africa was restricted primarily to tertiary education (universities and colleges) (Cadle, 2009). With the exception of a handful of private schools, visual arts (and design in particular) design education was barely represented at secondary education level. With the implementation of a revised national curriculum for schools in 2002 (known as General Education and Training – GET), this situation was set to change, especially as it would affect the preparedness of school-leavers intending to study visual arts and design at tertiary level after finishing their schooling (South Africa, Department of Education, 2005). This revised policy was named Curriculum 2005, proposed by the Department of Education (DoE) in 2002 to cover all school grades up to grade 9. This policy has its roots in the adoption of outcomes-based education (OBE), superseding the traditional 'aims-and-objectives' approach in South African schools adopted in 1997 and the subsequent phasing in of new curricula over the next ten years (South Africa, Department of Education, September 1997). Finally, in the Government Gazette of 27 July 2005, the new National Senior Certificate (NSC) for school-leavers was promulgated, making - yet again - provision for design education at a secondary school level, with the first cohort of school leavers in 2008 (South Africa, Department of Education 2005). These policies were encouraging for design education, as design and the visual arts were tacitly acknowledged as making an equivalent educational and economic contribution as the fields of agriculture, business, engineering, law, health sciences and mathematics(Cadle, 2009).

The 'anonymity' of UoTs, together with increasing difficulty for students to find employment because "they are often described by employers as lacking the skills needed" (Reddy *et al.*, 2000), lie central to the context of this study. Design education at UoTs in South Africa is clearly in flux. This possible changeable situation can be viewed as an advantage within the context of this study, as it allows for new direction and thoughts around teaching and learning methodologies.

3.5 Landscape Architecture Education: International and national contexts

Rogers (2010:12) defines the Landscape Architecture as:

> The profession, which applies artistic and scientific principles to the research, planning, design and management of both natural and built environments. Practitioners of this profession apply creative and technical skills and scientific, cultural and political knowledge

> in the planned arrangement of natural and constructed elements on the land with a concern for the stewardship and conservation of natural, constructed and human resources. The resulting environments shall serve useful, aesthetic, safe and enjoyable purposes.

The Landscape Architecture *profession* utilizes principles that are deeply rooted in science and arts. Landscape Architects must be able to not only effectively plan, manage and research both built and natural environments but must also, to be creative and analytical, employ community participatory approaches that factor in the culture and politics of the environment (Williams, 2016).

According to Burnes, Ortacesme, Stiles, De Vries, Holden and Jorgensen (2010), Landscape Architecture *education* aims to apply an increasingly broad range of theories from a growing number of disciplines to the challenge of developing planning and design processes. They aim to take into account multi-layered views of the complexity of the landscape and its associated meanings and values for individuals, groups and society as a whole.

The above interpretation of Landscape Architecture education highlights two main methodological characteristics. The first characteristic concerns the importance of interdisciplinarity. The theory and methodology of Landscape Architecture has much in common with other academic fields such as urban and landscape studies, cultural and natural geography, biology, ecology and forestry. The second characteristic concerns the fact that Landscape Architecture is a field of practice. Therefore, theory and methodology of Landscape Architecture should focus on the specific circumstances of human environmental action. Here, the theory of Landscape Architecture coincides with several other fields of study and new epistemological perspectives, such as 'practice based' research, 'experience-based' or 'situated knowledge', 'action research', 'research-by-design', 'design-led innovation', or 'research in and through the arts'. These are all examples of attempts to articulate and emphasize integrative ways of knowing, strategies for 'reflection-in-action', or means to enable collaboration between a broad range of stakeholders (Burnes *et al.*, 2010).

3.5.1 Landscape Architecture Education: International context

The profession of Landscape Architecture is defined by the two paradigms which emerged after World War I: conservation/planning, and aesthetics (McHarg, 1992). Over time this division has reinforced a perceived dichotomy between research and design, and between rigorous academic pursuits and practical professional skills (Feldhusen & Poerschke, 2015; Milburn, Brown, Mulley & Hilts, 2003). Traditionally, the academic practice of Landscape Architecture has focused on the preparation of students to enter and participate in the profession. Increasingly, however, university administrators are demanding that Landscape Architecture lecturers participate in research and scholarly activities. This is complementary to the generally increasing demand for research from the public and private sectors to provide justification for design and planning decisions (Bührs & Schoeman, 2009; Fenn & Hobbs, 2011; Steinø & Davidsen, 2017). Consequently, the role of the academic is changing from one focused on professional education, to one that includes contributing to research and to the development of the discipline (Milburn *et al.*, 2003).

The movement from modernism to post-modernism has slowly been reflected in a changing approach to design (Milburn & Brown, 2003). The modernist movement encouraged a perception of the designer as omnipotent artist and creator, making decisions based primarily on aesthetic, financial, theoretical, and political concerns. The move to post-modernism has placed a greater emphasis on issues, such as social responsibility, sustainability, environmental responsiveness, environmental integrity and human health. The complexity of these issues is encouraging educators of urban and regional planners, architects, interior designers and landscape architects to incorporate these issues as essential components of responsible planning and design processes (Akbulut, 2010; Lawson & Dorst, 2015; Schön, 1983).

Discourses in professional practice and professional education in Landscape Architecture have become entangled in the credence of 'ecologically sustainable development' (Lawson, 2010). Bulkeley (2006) points out that sharing personal experiences and reflecting on those experiences have been found to be influential in converting tacit or implicit knowledge to explicit, transferable forms of knowledge in professional practice. Furthermore, Poxon (2001) reports that design graduates place emphasis on critical thinking and evaluation, while design practitioners want graduates to bring a portfolio of competencies and skills to the workplace. Marušič (2002) calls for educators in Landscape Architecture to ensure the comprehensiveness of their programmes in the face of expanding knowledge of ecological processes while enhancing the creativity of both landscape planning and design.

3.5.2 <u>Landscape Architectural Education: National context</u>

In South Africa there are currently three institutions that offer programmes in Landscape Architecture that are accredited by the South African Council for Landscape Architecture (SACLAP). These institutions include:

- University of Pretoria (UP)
  The University of Pretoria offers a three-year full-time degree programme, BSc(LArch), as the first of two degrees required for admission into the profession of Landscape Architecture. The BSc(LArch) degree is preparatory to the BL(Hons) (minimum 1 year

full time) and ML(Prof) (minimum 1 year fulltime) degrees. The University of Pretoria also awards research Master's and Doctoral degrees in Landscape Architecture.

- University of Cape Town (UCT)
  The School of Architecture, Planning and Geomatics at the University of Cape Town offers a two year, full-time or three year extended post-graduate course (professional), leading to a Master of Landscape Architecture. The University of Cape Town also awards research Master's and Doctoral degrees in Landscape Architecture.
- Cape Peninsula University of Technology (CPUT)
  The Cape Peninsula University of Technology offers both a three-year full-time diploma programme (Diploma in Landscape Architecture), and a one year advanced diploma programme (Advanced Diploma in Landscape Architecture). The Advanced Diploma in Landscape Architecture articulates to the Master of Landscape Architecture degree at the University of Cape Town.

Nationally, CPUT and UP offer the only undergraduate programmes in Landscape Architecture. The current Landscape Technology programme of CPUT was developed in 1994 during a re-curriculation phase in conjunction with other then technikons and members of the 'green industry' to train students for a variety of careers within the landscape and horticulture industries.

The South African Landscape Architectural industry is regulated by the South African Council for the Landscape Architectural Professions (SACLAP). SACLAP was established in 2001 as a statutory council in terms of Section 2 of the South African Council for the Landscape Architectural Profession Act, Act 45 of 2000 (SACLAP, 2000). The Landscape Architecture profession has been mandated to transform (Volmer, 2016). This transformation, according to Volmer (2016), includes formalising qualifications and professional registration with statutory bodies. SACLAP strives to establish, direct, sustain and ensure a high level of professional responsibilities and ethical conduct within the art and science of Landscape Architecture with honesty, dignity and integrity in the broad interest of public health, safety and welfare of the community. SACLAP is mandated to accredit all tertiary academic qualifications in the Landscape Architecture (Volmer, 2016).

To become a professional Landscape Architect, a professional Master's degree is required by the SACLAP. Landscape Architects must register as a Candidate Professional Landscape Architect with SACLAP, once they have obtained an accredited professional Master's degree in Landscape Architecture. After a minimum period of two years working under a Professional Landscape Architect, they can submit a report and portfolio for consideration into the Professional Examination that is offered once a year (Volmer, 2016).

The South African Landscape Architectural industry also has a voluntary institute for Landscape Architecture in South Africa (ILASA)[1], registered with the South African Council for the Landscape Architectural Profession. The Institute for Landscape Architecture in South Africa has three regional bodies that represent members countrywide, namely one in the Western Cape (ILASA Cape), one in KZN (ILASA KZN) and one in Gauteng (ILASA Gauteng).

3.6 An institutional context: Cape Peninsula University of Technology

3.6.1 Brief background synopsis

Mathee (2015) has referred to a UoT, previously known as a technikon, as a 'glorified high school'. Before the restructuring of the higher education landscape in South Africa, technikons were quality controlled by the Certification Council of Technikon Education (SERTEC) nationally. Accountability then seemed remote and secondary. The then traditional (academic) universities established the Quality Promotions Unit (QPU) to prepare themselves for the establishment of the Higher Education Quality Committee (HEQC) (Reddy *et al.*, 2000). From the technikon perspective, the new national HEQC would provide institutional autonomy that filtered downward to programme level, affecting not only the programme structure, but also the course content, and therefore more accountability. One of the main foci of technikons, as training institutions, was to provide a professional workforce to industry. They fulfilled this commission very successfully, mostly because of the clear mandate given to them. Du Pré states: "What UoTs then need to become are centres of technology excellence, and not try to duplicate what traditional universities are so good at, and are geared to do" (Du Pré, 2010:7). The result was epistemic drift, away from the 'first commandment' (industry) and towards the 'eleventh' (world class applied research) (Mathee, 2015). The epistemic drift influenced the teaching of industry practice in the classroom, not in curriculum, but in approach and methodology, in pedagogy.

The history of CPUT goes back to 1920 when the cornerstone of the Long Market Street Building of the then Cape Technical College was laid in Cape Town. The establishment of the college resulted more than ten years of representations by the community for the consolidation of the technical courses which had been offered in various venues in town (Grobbelaar, Tijssen & Dijksterhuis, 2017).

In 1962, the Peninsula Technical College was established to cater for the steady growth in the number of coloured apprentices in a variety of trades. Classes were conducted in Cape Town until the relocation to the venue in Bellville in 1967. After the promulgation of the Technikons Act in 1976, technical colleges were able to offer tertiary education in selected fields of study.

[1] https://www.ilasa.co.za/about-ilasa

During 1979, both colleges were legally established as technikons (Cape Technikon and Peninsula Technikon) and from 1993 they were empowered to offer degrees: Bachelors, Master's and Doctoral degrees in Technology (Rust & Uys, 2014).

The Cape Peninsula University of Technology (CPUT) was established on 1 January 2005 when the Cape Technikon and the Peninsula Technikon merged. This merger was part of a national restructuring process that transformed the higher education landscape in South Africa. Today, this institution is the only university of technology in the Western Cape and is the largest university in the region, boasting more than 30 000 students, several campuses and service points and more than 70 programmes. The university has six faculties offering a wide range of accredited undergraduate and postgraduate programmes in the fields of applied sciences, business, education and social sciences, engineering, informatics and design as well as health and wellness sciences. The institution has campuses in the following location(s): Cape Town, Bellville, Mowbray, Wellington and Greenpoint. It is officially registered at the Department of Higher Education and Training. CPUT offers programmes leading to officially recognized higher education degrees such as pre-bachelor degrees (i.e. certificates and diplomas), bachelor degrees, master's degrees, doctorate degrees in several areas of study.

The academic drift of the UoTs, coupled with the massive re-curriculation burden and the need/call for curriculum transformation, might have resulted in what is referred to as 'epistemicide' (CPUT, 2017). In other words, CPUT has not set out to fully explore, in more advanced forms, what is meant by knowledge in practice (or phronesis) - as opposed to more theoretical knowledge (or episteme) and technical knowledge - and how these can be taught within the context of curriculum transformation/decolonisation (CPUT, 2017).

The institutional transformation agenda is guided by four main policy/guideline documents: Vision 2020, the 2012/13 Transformation Strategy, the 2014 Strategic Goals, and Curriculum 2020. The relevant sections of Vision 2020 promote a focus on innovative curriculum design that is intended to enhance student equity and engagement both within the university and outside with workplaces and community. The transformation strategy encourages the university to, inter alia, "develop responsive curricula to enhance social cohesion and diversity in (and outside) the classroom" (CPUT, 2017:12). The 2014 strategic goals exhort the university to continually develop and adapt curricula to better suit the needs of students and the changing society they will enter.

While empirical research (Scott, Yeld & Hendry, 2007) has revealed undesirably low throughput rates at South African universities, a consideration of the specific situation at CPUT demonstrates that low throughput rates are evident in all faculties. In the Faculties of Engineering and Applied

Sciences, only 14.6% and 33.2% of diploma students admitted between 2002 and 2006 respectively completed their qualifications in regulation time (Ivala, 2009).

3.6.2 Diploma in Landscape Architecture

The Diploma in Landscape Architecture evolved in the early 1990's from the National Diploma in Horticulture, with majors in Horticulture and Landscape Planning, which was offered since the late 1970's. The National Diploma in Parks and Recreation Management was the only other tertiary qualification that had a strong horticultural emphasis offered during that time. The former led to the graduation of horticulturists for employment in the general horticulture and landscape industry, the latter led to the certification of parks and recreation managers, most of whom were employed in the municipal, state and semi-state sector. As a direct result of a strong input from the landscape industry, the National Diploma in Landscape Technology was instituted for the first time after the revision of all horticultural curricula in the early 1990's. The major reason for this was the need to train horticulturists (or landscape technologists, as graduates were called) in landscape design, construction and plant material studies (the latter included botany, plant identification, plant use and maintenance). During the subsequent twenty-five years, landscape technologists have graduated from various UoTs and have been employed in all sectors of the horticulture and landscape industry. Their major input into the industry has been their adaptability to one or more of the focus areas of landscape design, construction and plant usage.

The BTech degree in Landscape Technology was instituted during the 1990's and offered students the opportunity to extend their studies in the focus areas mentioned above, but to also gain a capacity for research, which was aimed at either further research studies or the use of research techniques in work problem solving.

As a result of the development of the National Qualifications Framework (NQF) by the South African Qualifications Authority (SAQA) and the need to revise all curricula and align these to the NQF, CPUT has successfully completed re-curriculation of the National Diploma in Landscape Technology. This was in response to the National Qualifications Framework (NQF) Act No 67 of 2008 that replaced the South African Qualifications Authority (SAQA) Act No 58 of 1995, and came into effect on 1 June 2009. The NQF Act changed the NQF from an eight (8) level framework to a ten (10) level framework. This was the first major revision of the curricula for this Diploma and BTech since their inception. The National Diploma was replaced by an NQF Level 6 Diploma in Landscape Architecture. As a fourth year of study, the BTech Landscape Technology will be replaced by the Advanced Diploma in Landscape Architecture at NQF Level 7. Approval to offer the diploma in 2017, and the Advanced Diploma in 2020, has been received.

The diploma, as described by the SACLAP Table of Core Competencies (SACLAP, 2016), will widen access to higher education by ensuring vertical and horizontal alignment for candidates within the green profession:

- Horizontal alignment: As a result of the new course structure, students will be able to get credits for subjects at local and international tertiary institutions.
- Vertical alignment: After graduation, students will be able to move on to higher qualifications. It also makes registration in higher professional categories at other local traditional universities, e.g. UP and UCT, possible.

The programme represents the two core aspects of the landscape industry: landscape design and landscape construction. The skills required in this field in South Africa are set out by the SACLAP core competencies table and include professional practice, design, horticultural knowledge and construction.

3.6.3 Foundation Programme: Diploma in Landscape Architecture

Foundation programme (short for Foundation Phase programme) is a programme type running at most universities in South Africa. Terms like Extended Curriculum Programme (ECP) and Extended Degree Programme (EDP) are synonymous with Foundation Programme. Fundamentally, the programme acts as a 'bridge' for underperforming students to ease into academic study (Bozalek *et al.*, 2011).

Foundation programmes are regular degree or diploma programmes which are extended with additional support for learning (Hutchings *et al.*, 2010). The objective of these programmes is to provide disadvantaged students with the means to stay in their chosen university course and to stand a good chance of graduating within the given time (Department of Higher Education and Training, 2006). Earlier models for foundation programmes focused on teaching students skills, for example reading and writing skills, in order to deal with subject knowledge at the university level - the assumption being that inadequate schooling has not suitably prepared students for higher education study (Bozalek & Boughey, 2012). The current dominant approach to foundation offerings has shifted the focus from student unpreparedness for university to making the ways in which subject knowledge is constructed and produced, or epistemology, more transparent (McKenna, 2004; Bozalek & Boughey, 2012; Hutchings *et al.*, 2010).

Foundation programmes can take on various forms or models for different courses, based on the model that works best for the course. These models could be any one of the four below:

- Fully Foundational Course – In this type of foundational offering, students complete a course that will adequately prepare them for the mainstream course that the students will feed into after completion of the foundational offering.
- Extended Course – In this type of foundational offering, the mainstream course is combined with foundational material. The course would therefore cover the same material as the mainstream course, but additional time is allocated to incorporate assistance (foundational) to students. For example, where a mainstream course would take six months to complete, the extended course would be offered over a year.
- Augmented Course - In this type of foundational offering, the duration of the course is the same as the mainstream, but additional classes are offered to provide foundational support. This essentially means the number of subjects offered in a block (for example, semester) would be halved to allow for the additional foundation support.
- Augmenting course – In this type of foundational offering, the foundational support runs simultaneously with the mainstream course, but is offered as an additional and separate module (Garraway, 2017)

The Extended Curriculum Programme (ECP) of CPUT takes on approximately 1250 first-time entering students annually, approximately 15% of the total first year intake (Garraway, 2017). The ECP initiative at CPUT aims to provide students, who otherwise might have struggled to succeed in the first year and beyond, with the ways of thinking, being and doing within their fields. It does this in two ways. Firstly, there is a focus on access to the disciplinary knowledge of the field (for example maths or economics) through focusing teaching and learning on the central guiding principles of different subjects, or at least on those areas that lecturers know students struggle with (referred to as epistemological access). In terms of the latter, an essential and developing step is to understand what students bring with them from schooling and social life, what could be used to promote learning, and which particular areas need to be focused on in order to help students navigate their courses. Secondly, students are introduced to some of the ways of thinking and doing in their professional life (for example, through project work and site visits) so as to both motivate students and to help them understand how different subject knowledge may be synthesized into a work-directed programme.

The CPUT Landscape Architecture Foundation programme has as its purpose to give talented but underprepared students epistemological access to the general field of design, as well as to a range of specific Landscape Architecture disciplines. At the end of the programme, students progress to the first year of the Diploma in Landscape Architecture.

The official purpose of this programme is redress; that is, widening access to talented and qualified school leavers who, due to the legacy of apartheid education, would have had limited, if any, exposure to design at school. The studio-work component of the curriculum has two aims: to introduce students to foundational or core design knowledge common to Landscape Architecture, and to provide students with a clear, experienced-based understanding of the discipline. In spite of its redress purpose, the tacit nature of design pedagogy may in fact disadvantage learners who have not been socialized into the particular forms of knowledge and dispositions required for design.

3.7 **Conclusion**

This chapter introduced the broad context of design education and specifically Landscape Architectural education in South Africa, wherein this study is situated - highlighting the trends and discussing contextual issues facing design education at UoTs and the South African design industry. In the following chapter, the research methodology of the study will be discussed.

Chapter 4 :

RESEARCH PARADIGM, DESIGN AND METHODOLOGY

4

"The research process, then, is not a clear cut sequence of procedures following a neat pattern, but a messy interaction between the conceptual and empirical world"

(Bryman & Burgess, 2003:2)

4.1 Introduction

In recent years, the importance of narrowing the chasm between research and practice has come to the fore. Research that is detached from practice "may not account for the influence of contexts, the emergent and complex nature of outcomes, and the incompleteness of knowledge about which factors are relevant for prediction" (Design-Based Research Collective, 2003:5). The present study was ultimately about addressing practical questions concerning design skill set enhancement in a real, authentic context, in collaboration with practitioners and going beyond the narrow measures of learning in an attempt to evaluate the effectiveness of an innovative intervention. To this end, a more pragmatic ideology, supported by a design-based approach with a combination of qualitative and quantitative data collection methods, was employed to investigate the research questions in the present study.

In this chapter, the research paradigm, design and methodology are discussed in detail. The Design-Based Research (DBR) framework is defined and the characteristics are sketched. The specifics of the data collection methods, as well as the unique research conditions and sample features, are explained. Chapter 4 coincides with Phase 1 (analysis and exploration of the problem), as illustrated in Figure 4.1.

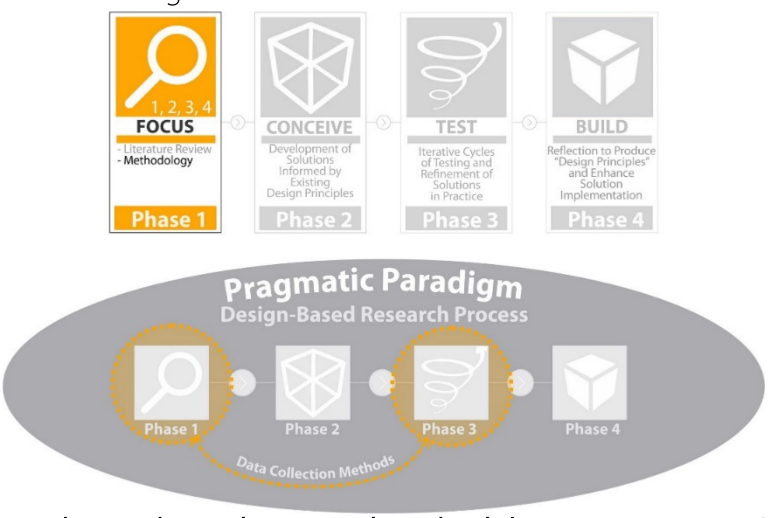

Figure 4.1: Research paradigm, design and methodology – positioning Phase 1

4.2 Research population

The research participants consisted of the 2017 cohort of Landscape Architecture Foundation Programme students in the Diploma in Landscape Architecture at the Department of Horticulture, CPUT (N=25) (see section 3.6.3). The whole population was used as the sample of analysis.

4.3 Research paradigm

Research, as portrayed by Burns (1994), is a systematic investigation or inquiry whereby data are collected, analysed and interpreted. This is further clarified by Mertens (2010) as an endeavour to understand, describe, predict or control an educational or psychological phenomenon or to empower individuals in such contexts. Mertens (2010:2) furthermore acknowledges that "the exact nature of the definition of research is influenced by the researcher's theoretical framework", with theory being used to establish relationships between or among constructs that describe or explain a phenomenon by going beyond the local event and trying to connect it with similar events. The theoretical framework, as distinct from a theory, is referred to as the paradigm and influences the way knowledge is studied and interpreted (Hesse-Biber & Leavy, 2006; Mertens, 2010; Johnson & Onwuegbuzie, 2004).

A paradigm could include ontology, epistemology, methodology and methods (Creswell, 2009; Anderson & Shattuck, 2012). Ontology is "the study of being" (Klein, 2003:142). Ontological assumptions are concerned with what constitutes reality. For example, as a researcher one could conclude that there is a 'real' objective world out there, or that reality is constructed through human relationships. Each paradigm has an epistemology – a set of assumptions about the relationship between the 'knower' and the 'known' (Barab & Squire, 2009), that is, how knowledge is created, acquired and communicated. For example, does the knower need to be 'objective' and affect the outcome as little as possible, or does the knower actively co-construct knowledge with others? In the present study, for instance, the latter epistemological stance was assumed.

Scotland (2012:9) points out that "different paradigms inherently contain differing ontological and epistemological views; therefore, they have differing assumptions of reality and knowledge that underpin their particular research approach". This is reflected in a paradigms' methodology and methods. Methodology is the strategy, approach or plan of action that lies behind the choice and use of particular methods (Crotty, 1998). Methodology is therefore concerned with why, what, from where, when and how data are collected and analysed. In the present study, the DBR approach guided the research design. Methods, on the other hand, are the specific techniques and procedures used to collect and analyse data (Scotland, 2012), referring to either qualitative or quantitative, or in the case of the present study, both data-collection categories.

In the field of education, several research paradigms exist - guiding different methods being used. Researchers with an objectivist epistemological preference tend to favour quantitative data collection methods, whereas researchers with a constructivist epistemological disposition lean towards qualitative data collection methods (Johnson & Onwuegbuzie, 2004; Scotland, 2012). Javed (2008:75) remarks that "for a long time, research purists have maintained that these two epistemological positions are mutually exclusive and that researchers should avoid mixing them in their research". Teddlie and Yu (2007), however, propose another research paradigm based on pragmatic ideology, concerned with practical consequences of an intervention and promoting mixed-method research. Feilzer (2010:8) explains that pragmatism sidesteps the contentious issues of truth and reality and accepts, philosophically, that there are singular and multiple realities that are open to empirical inquiry and "orients itself toward solving practical problems in the real world". In order to position the pragmatic paradigm of the study, Table 4.1 offers a summary of the main paradigms in social science research (Anderson, 2013).

Table 4.1: Summary of four different research paradigms

PARADIGM	ONTOLOGY	EPISTEMOLOGY	METHOD
Positivism	Hidden rules govern the teaching and learning process	Focus on reliable and valid tools to undercover rules	Quantitative
Interpretive/ Constructivist	Reality is created by individuals in groups	Discover the underlying meaning of events and activities	Qualitative
Critical	Society is rife with inequalities and injustice	Helping uncover and empowering citizens	Ideological, review and civil actions
Pragmatic	Truth is what is useful, reality is the practical effects of ideas	The best method is one that solves problems	Mixed methods and Design-Based Research

Source: Adapted from Anderson, 2013

According to Javed (2008:81), positivist and post-positivist paradigms "do not promote collaborative or participatory research where research is [orientated] towards bringing about change". The present study is participatory in the sense that the researcher directly participated in the design and implementation of the learning environment being researched and, from the start, a collaborative approach was highlighted by involving the participants in all the phases of the research process.

A fundamental assumption of 'learning scientists', according to Barab and others (2009), is that cognition is not located within the individual 'thinker' but as a process that is distributed across the 'knower', the environment in which the knowing occurs, and the activity in which the learner participates. Thus learning, cognition, knowing and context are intrinsically combined. For this reason, research paradigms that examine the processes of learning, cognition, knowing and context as isolated variables within a laboratory or other limited contexts, will result in an incomplete understanding and irrelevant interpretation of the research outcomes (Anderson & Shattuck, 2012). Learning, cognition, knowing and context, within this view, are therefore irreducibly co-constituted and cannot be treated as isolated entities or processes. Plowright (2011:184) further elaborates that knowledge and understanding is "neither static nor certain". Highlighting that context matters, especially in terms of learning and cognition, and within the pragmatic paradigm, the DBR framework thus advances design, research and practice concurrently (Joseph, 2004).

Pragmatism allows the researcher to use multiple methods of data collection and analysis, different world views and assumptions, aiding in answering the research questions and not committing to one particular philosophy and reality (Creswell, 2009; Mertens, 2010). This study assumed a pragmatic paradigm and more specifically implemented a DBR framework, using both qualitative and quantitative methods to generate data.

4.4 **Introducing Design-Based Research**

In most educational settings, one of the fundamental assumptions of empirical research is that practitioners will apply theories and research findings in order to improve their practice. However, there is often no clear link between changes in practice and results of research (Corbin & Strauss, 2010). Design-Based Research (DBR) evolved at the beginning of the 21st century as a practical research methodology that provides a bridge between theory and practice in a classroom context (Goff & Getenet, 2017).

Design-Based Research, also called design experiments (Brown & Collins, 2007), design research (Collins, Brown & Newman, 1987) or educational design research (McKenney & Reeves, 2012), have increasingly generated interest among educational researchers in the last decade (Anderson & Shattuck, 2012). Wang and Hannafin (2005:6) define DBR as:

> "A systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings and leading to contextually-sensitive design principles and theories"

Each definition has a slightly different focus, but the underlying goals and approaches are similar. Most importantly, DBR is relevant for educational practice as it aims to develop research-based solutions for complex problems in educational settings. In addition, Anderson and others (2012) accede that a real educational context provides a sense of validity to the research and ensures that the results can be effectively used to assess, inform and improve practice in at least one, and most likely in other contexts (Wang & Hannafin, 2005).

4.4.1 Characterizing Design-Based Research

DBR is increasingly gaining recognition in the field of learning and instruction. In DBR, practitioners and researchers work together to produce meaningful change in contexts of practice (DBRC, 2003). Through a collaborative process, empirical investigation takes place and valuable insights are gained for the development of learning theories as well as learning resources (Hoadley, 2004). Commensurate with the twin goals of meaningful change in practice and deriving theoretical understanding, design research communities are characterized by "innovativeness, responsiveness to evidence, connectivity to basic science, and dedication to continual improvement" (Bereiter, 2002:321).

The Design-Based Research Collective[2] (2003:5) proposes the following characteristics of DBR:

- The goals of designing learning environments and developing 'conjectures', theories or 'prototheories' are closely linked.
- Development and research take place through continuous cycles of design, enactment, analysis and redesign.
- Research on design must lead to sharable theories that help communicate relevant implications to practitioners and other educational designers.
- Research must provide an account for how designs function in authentic settings. The account should focus on interactions that refine our understanding of the learning issues involved.
- Research relies on methods that can document and connect processes of enactment to outcomes of interest.

The essence of the above characteristics of DBR are denoted by Wang and others (2005:45) as being "pragmatic, grounded, interactive, iterative, and flexible, integrative, and contextual" (see Table 4.2 for a more detailed explanation of the five basic characteristics).

Table 4.2: Characteristics of DBR

CHARACTERISTICS	EXPLANATIONS
Pragmatic	• DBR refines both theory and practice

[2] The Design-Based Research Collective (DBRC) is a group of faculty and researchers founded to examine, improve and practice DBR methods in education (see http://www.designbasedresearch.org)

	• The value of theory is appraised by the extent to which principles inform and improve practice
Grounded	• Design is theory-driven and grounded in relevant research, theory and practice. • Design is conducted in real-world settings and the design process is embedded in, and studied through, DBR.
Interactive, iterative and flexible	• Designers are involved in the design processes and work together with participants. • Processes are iterative cycles of analysis, design, implementation and redesign. • The initial plan is usually insufficiently detailed so that designers can make deliberate changes when necessary.
Integrative	• Mixed research methods are used to maximize the credibility of ongoing research. • Methods vary during different phases as new needs and issues emerge and the focus of the research evolves. • Rigor is purposefully maintained and discipline applied appropriate to the development phase.
Contextual	• The research process, research findings and changes from the initial plan are documented. • Research results are connected with the design process and the setting. • The content and depth of generated design principles vary. • Guidance for applying generated principles is needed.

Source: Adapted from Wang & Hannafin, 2005

DBR positions researchers with practitioners as parts of a team that work together, usually over an extended period of time, to provide a solution(s) to a practical problem in a specific educational context (Anderson & Shattuck, 2013). This collaboration demands the development of solutions to practical problems in learning environments, with the identification of reusable design principles. This is a major driving force of the research (Goff & Getenet, 2017). As a result, there is an assumption embedded within the educational field that DBR appears to be a long-term and intensive approach to educational inquiry. This assumption often projects the notion that doctoral students should not attempt to adopt this approach for their dissertations (Herrington *et al.,* 2007).

However, some studies have begun to highlight the appropriateness of DBR for doctoral studies (Herrington *et al.,* 2007; Kennedy-Clark, 2015) . For example, Kennedy-Clark (2015) suggests that the DBR approach can provide a platform for higher degree research (HDR) students to apply a range of analysis methods, data collection tools, and techniques. Herrington and others (2007) provide guidelines on preparing the DBR proposal including, amongst other things, a sequential and practical description of proposed research. Similarly, Van den Akker, Bannan, Kelly, Plomp and Nieveen (2013) as well as Herrington and others (2007) clearly articulate the different phases in a DBR approach, making it easier for doctoral students to conceptualize the approach in action. However, there is still a limited amount of research on how to use the DBR approach, particularly in HDR or doctoral study contexts (Kennedy-Clark, 2015).

DBR studies use the term 'intervention' to denote the object, activity, or process that is designed as a possible solution to address the identified problem. McKenney and others (2012:12) define intervention as a broad term used "to encompass the different kinds of solutions that are designed". These solutions include educational products, processes, programmes, and policies. Herrington and others (2007:7) state that DBR is "not in itself a methodology, but a research approach. Both qualitative and quantitative methods" are utilised, but isolated variables are not emphasised.

Like action research, DBR is typically interventionist and open, involves a reflective and often cyclic process, and aims to bridge theory and practice (Bakker & Van Eerde, 2015). In both approaches the teacher can be also researcher. In action research, the researcher is not an observer (Anderson & Shattuck, 2012), whereas in DBR s/he can be observer. Furthermore, design is a crucial part of the research in DBR, whereas in action research the focus is on action that can (but need not) involve the design of a new learning environment. DBR also focuses more explicitly on instructional theories. The commonalities and differences between DBR and action research are summarised in Table 4.3.

Table 4.3: Commonalities and differences between DBR and action research

	Design-Based Research	Action Research
Commonalities	Open, interventionist, researcher can be participant, reflective cyclic process	
Differences	Researcher can be observer	Researcher can only be participant
	Design is necessary	Design is possible
	Focus on instructional theory	Focus on action and improvement of a situation

Source: Adapted from Bakker & Van Eerde, 2015

4.4.2 Design-Based Research process

Mantei (2008:132) reminds the Design-Based researcher to "use findings from careful analysis of data collected during the interventions to contribute to the existing body of research to provide a deeper understanding of the problem as well as having practical applications for classroom teaching and learning experiences". This research study therefore aimed at doing two things (formulated as the research objectives). Firstly, at the design level, its main objective was to develop and refine a framework that would enhance the design skill sets of students. Secondly, at the practice level, its main aim was to assess the feasibility and effect of the interventions for the development of these skill sets.

As mentioned earlier (4.3.1), DBR encompasses educational design processes and is, like all systematic instructional design processes, cyclical in character: "Analysis, design, evaluation and revision activities are iterated until a satisfying balance between ideals and realization has been achieved" (Van den Akker, *et al*, 2013: 14).

This research process has been visualized by different researchers in various ways (Amiel & Reeves, 2008; Barab & Squire, 2009; Herrington, McKenney, Reeves & Oliver, 2013), but the present study (see section 1.5) used the four-phase approach of McKenney and others (2015), depicted in Figure 8.2 as reference point. The four key phases are:

- analysis and exploration
- design and construction
- evaluation and reflection, and concurrent with each preceding phase
- implementation and spread.

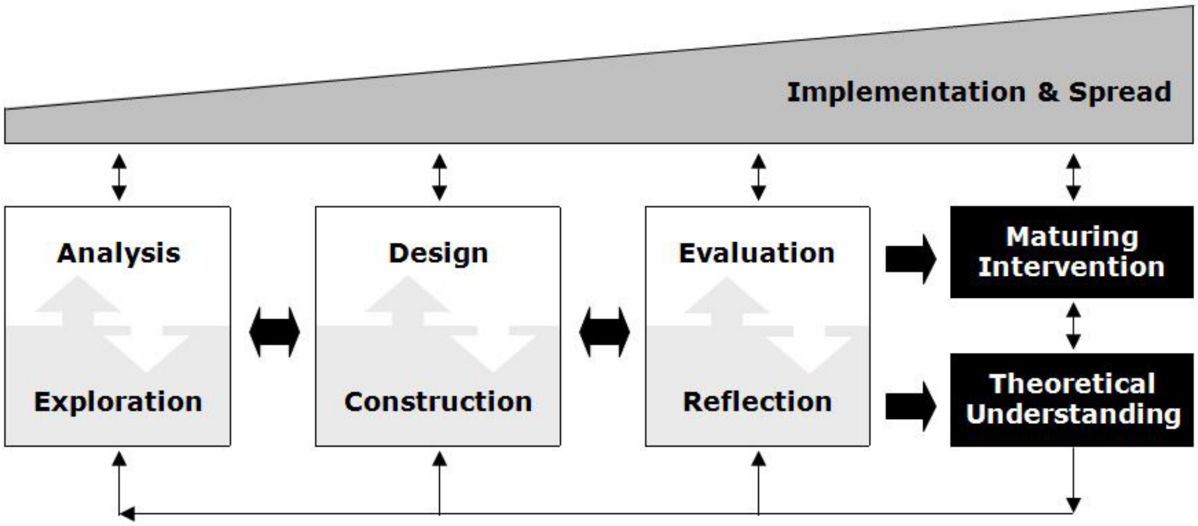

Figure 4.2: Generic model for conducting DBR
Source: McKenney & Reeves, 2012

In the following sections, each of the phases is described in connection with this investigation of how students' design skill sets can be enhanced (Figure 1.2).

4.4.2.1. Phase 1: Analysis of practical problems

As noted by Bannan-Ritland (2003:22): "The first phase of [design-based research] … is rooted in essential research steps of problem identification, literature survey, and problem definition". While these processes are common to most research approaches, they have a particular significance for design-based research. Herrington and others (2007:5) maintain that, for DBR in education, "the identification and exploration of a significant educational problem is a crucial first step, [because] it is this problem that creates a purpose for the research". Ultimately, the creation and evaluation of a potential solution to this problem form the focus of the entire study. Being a Design-Based researcher, it was important to start with the problem and work towards a solution informed by research, and not the other way round, i.e. having preconceived assumptions about likely solutions.

In order to formulate the fundamental purpose of this study, Phase 1 - from the beginning - relied on meaningful collaboration with practitioners and literature. The literature review process is critical in DBR because it not only performs "the usual functions associated with a review", but it also "facilitates the creation of draft design guidelines to inform the design and development of the intervention that will seek to address the identified problem" Herrington *et al.,* (2007:6). This highlights the literature review as a continual process of identifying the conceptual underpinnings of the problem in order to assist in understanding and prediction of solution elements. The literature review was comprehensively reported on in Chapter 2; the contextual framework of design education, specifically Landscape Architectural education, was discussed in Chapter 3, and the in-depth and context-specific analysis and exploration of the problem will be presented in Chapter 5 (see Figure 1.2).

During the pre-intervention phase of the study, the students participated in a Multiple Intelligence (MI) Survey and a design skill set evaluation, which consisted of three parts: a design assignment, a Participatory Action and Learning (PAL) project, and an informal and unstructured interview (Chapter 5).

The levels of the participants' design skill sets and MI scores (Chapter 5) correlated with the scores attained on the design assignment, highlighting the challenges of low design exposure and under-preparedness that the participants, namely Landscape Architecture students, experience. The evaluation of their perceptions on how they experienced the design process accentuated the issues in design education (Chapter 3).

This study proposes an innovative approach to develop and enhance design skill sets. Whereas Lawson (2005) hypothesizes that design is a highly complex and sophisticated skill, D'souza and others (2014) argue that design skills cannot be restricted to a unique skill, but rather embodies a flexible framework that consists of multiple abilities that designers intentionally use to achieve desired goals in specific design scenarios.

The central argument in this thesis: *is that students' creative ability is a combination of various skills that can be learned and taught. One way would be to see the development of these skills as a combination of multiple components, and through the theoretical perspective of Multiple Intelligence (MI) Theory, a combination of the components was implemented to stimulate design skill development.*

4.4.2.2. Phase 2: Develop solutions informed by existing design principles

The second phase of DBR focuses on developing a solution/solutions to the problem that can be implemented in the educational setting (Herrington *et al.,* 2007; Van den Akker *et al.*, 2013).

According to McKenney (2016), during the design and construction (not testing), a coherent process is followed and documented to arrive at a (tentative) solution of the problem, i.e. a conceptual model. While a general literature review that informed the exploration of the problem was conducted in Phase 1 (Chapter 2), the literature in the second phase was again scrutinized to identify and to list existing design principles that might have addressed a similar or parallel problem. These principles informed the design of the learning solution or intervention and potentially provided a solution to the problem (Herrington *et al.,* 2007).

Referring to Phase 2 of the DBR approach, Barab and others (2009:6) maintain that "design-based research suggests a pragmatic philosophical underpinning, one in which the value of a theory lies in its ability to produce changes in the world". Design education must encourage individuality of interpretation and expression by means of creating an environment that allows for multiple solutions and different perspectives. These environments must address how students perceive themselves, how they construct and share knowledge, and how they understand and apply the design process to resolve and develop creative outcomes. Herrington (2008) observes that traditional approaches in higher education have not resulted in appropriate learning outcomes. Research of alternative models of teaching and learning furthered the growing influence of constructivism as a philosophical approach to learning, and more specifically implementing 'authentic' teaching and learning environments. The challenge here lies in how effectively and substantively an alignment can be achieved between higher education teaching and learning, and the way that learning occurs in real-life settings (Herrington & Herrington, 2008).

After the first phase of identifying the problem (from the literature and context review), tentative design guidelines were put together informing the development of the first intervention. In the second phase, a possible solution was proposed: the design skill set enhancement framework consisted of a procedural structure, the design knowledge semiotic process, and a theoretical design pedagogical concept, design skill set modal agencies. The aims were therefore to enhance the students' design knowledge and facilitate the development of design skill sets.

4.4.2.3. Phase 3: Test and refine solutions in practice (iterative cycles)

Once the intervention has been designed and developed, the next phase of DBR encompasses the implementation and evaluation of the proposed solution in practice. Anderson and others (2012:2) refer to this creation and testing of prototypes, iterative refinement and continuous evolution of the design, as it is tested in authentic practice, as "research through mistakes".

Design-based interventions are rarely, if ever, designed and implemented perfectly; there is thus always room for improvements in the design and subsequent evaluation. This evolution through multiple iterations is but one of the challenges of the methodology in that it is difficult to know when (if ever) the research programme is completed (Anderson & Shattuck, 2012).

This phase largely constituted the data collection and analysis stage of the study, and details of the implementation and evaluation of the proposed solution are provided in Chapters 7 and 8. Recognising the complex, multilevel, iterative, multivariate and interventionist nature of research in design studies, Shavelson, Phillips, Towne and Feuer (2015) argue for intensive, iterative studies that trace the design process and capture meaning constructed by individuals over time, with the intent of improving the effectiveness of instructional tools to support learning. The retrospective interpretation produces a situated, narrative account of learning and how it can be supported and structured (Cobb, Confrey, DiSessa, Leher & Schauble, 2003). The retrospective analysis places this study in a broad theoretical context that indicated if and how the design skill set Framework has enhanced the skill sets of the participants. Chapter 7 represents the implementation and evaluation of the design skill set framework, coinciding with the first part of the Phase 3 of the DBR process. Chapter 8 represents the latter part of Phase 3 of the DBR process, aimed at providing a rigorous in-depth interpretation of the data, more specifically the data of three stratified (sampled) selected participants and delving deeper into the design skill set heuristics that emanated from the multiple intelligence conjecture-driven teaching experiment. The stratified sampling method, according to Gay, Mills and Airasian (2012), is a way to guarantee desired representation of relevant subgroups within the sample. The participants' results of design assignment 1 (Chapter 5) were used to group all the participants into three subgroups: low (0.0 – 1.9 marks), medium (2.0 – 2.5 marks) and high (3.0 – 5.0 marks) (see Table 6.2 in Chapter 6). Through the stratified sampling process, participants from each subgroup were strategically selected (Gay *et al.*, 2012).

As was indicated earlier, DBR is typified by iterative cycles of analysis, design enactment and review. The present study had four iterations (cycles) of development, implementation and evaluation of the design skill set framework. Four different design theoretical concepts, elements and principles of design, were taught during the four iterations, with a different theoretical concept taught in each iteration cycle. Each cycle started with a theoretical concept after which a two-stage design skill set modal intervention was implemented, followed by reflection and refinement. A similar process was followed for all four cycles. All four cycles took place during 2017 and the same cohort of students was involved.

During each iterative cycle, various measures were used "to gain a deeper understanding of the factors affecting the design" and particularly "the effectiveness of the planned innovation" (Javed, 2008:77). Each iterative cycle consisted of two stages. During stage 1, a theoretical concept was explained through a set of modal agencies. This set of interventions consisted of 3 x 40 minute consecutive periods of interactive class time. Subsequently, stage 2 was implemented a week later for cycle 1 and 2, and was changed the next day for cycle 3 and 4. This stage consisted of 3 x 40 min consecutive periods during which a formal design assignment, a participative action and learning (PAL) assignment and an informal and unstructured group interview were completed. The PAL assignment consisted of a reflective drawing assignment and a verbal report on the drawing (video recording). In Cycles 1 and 2 students had to draw a Moodline diagram, and in Cycles 3 and 4 they had to draw a Venn diagram to indicate the resources they used during their design process for the design assignment – the sizes of the circles were indicative of the resource contribution to their design process. The purpose of the design assignment was to assess their design performance according to quality of design ideas and design solutions. A design idea was understood as a schematic or abstract representation of a design thought and a design solution was conceived as a concrete representation of a design output.

A detailed discussion of the specific instruments used in the evaluative cycles follows in Section 4.4.4 and in the data analysis of Chapter 7.

4.4.2.4. Phase 4: Reflect and produce design principles

The engagement with this recursive process resulted in an appreciation of the theoretical underpinnings of the guiding principles for the development of a framework that could enhance the design skill sets of students in the form of design orientated semiotic processes and modalities. DBR implies outputs in the form of both knowledge and products. The knowledge component takes the form of design principles (Chapter 9) that are "evidence based heuristics that can inform future development and implementation decisions" (Herrington *et al.,* 2007:8). On the other hand, as a design field, the dominant research goal is to solve teaching, learning and performance problems and the product of design is therefore viewed as a major output (Bakker & Van Eerde, 2015; Van den Akker *et al.*, 2013). Herrington and others (2007:8) further draw attention to what they refer to as 'societal outputs'. The collaborative nature of DBR enhances the professional development of all involved. The goal of these principles is not to create a set of mandatory esoteric procedures for lecturers to implement, but rather to facilitate bridging the gap between educational theory and practice (Herrington & Reeves, 2011).

Phase 4 produced many reflective outputs in an attempt to solve the research problem identified in Phase 1 and these are presented in Chapter 9.

4.4.3 Data collection methods

The data collection methods used is determined by the chosen paradigm (see Section 4.2). In this study, pragmatism supported the use of multiple methods, including different forms of data collection and analysis in order to promote a contextually sensitive outcome with an action orientation.

DBR is not a specific data collection and analysis method, but rather a framework that facilitate the use of other specific methods and techniques, such as video, verbal data and statistical analysis (Cohen, Manion & Morrison, 2011). Following a mixed-method approach embedded in the DBR framework, this study collected both qualitative and quantitative data to complement each other, to enrich findings and to draw meaningful conclusions.

The following sections describe the various methods used during the study and link them to specific phases in the DBR process.

4.4.3.1. Assessing Multiple Intelligences

This data collection method was used during Phase 1 (analysis and exploration of the problem) of the DBR process (Figure 5.1). To address the first objective of the present study (to investigate the required design skill sets for undergraduate design students), the students' multiple intelligences had to be measured.

Since the introduction of multiple intelligences theory (MIT) by Gardner (1993), interest has been growing internationally in the role and assessment of multiple intelligences (MI) with regard to learning, achievement and knowledge acquisition. Based on the evidence gained from research in biology, genetics and psychology, Gardner (1993) suggests the existence of eight relatively autonomous, but interdependent, intelligences rather than just a single construct of intelligence. He redefines the concept of intelligence as "the ability to solve problems or fashion products that are of consequence in a particular cultural setting or community" (Gardner, 1993:45).

As mentioned in Chapter 2, the traditional education system focused on only two intelligences, namely linguistic and logical mathematical (Gardner, 2011; Goodnough, 2001). Only these two intelligences were valued and tested. Individuals who were weak in either of these intelligences were often disadvantaged by the education system (Sorin-Avram, 2015; Hanafin, 2014). Education, and more specifically design education, must be made more effective and relevant for a larger and necessarily more diverse fraction of the population (cf. section 2.4). Akkuzu and others (2011) suggested that education must be reformed and innovated in terms of educational contents, teaching tools and measures in order to adapt to the need of versatile and innovative abilities in the era of knowledge.

MI theory, according to D'souza and Chandrasekhara (2014), assume that intelligences, and the mastery of specific domains (e.g. drawing and dance etc.), could be linked to the mastery of specific groups of intelligences (i.e. kinesthetic intelligence, spatial intelligences etc.).

The research instrument used to measure the student cohort's multiple intelligences was the Multiple Intelligence Development Assessment Scale (MIDAS) Questionnaire. MIDAS was developed by Shearer (1997) and is intended to give a reasonable estimate of a person's intellectual disposition in each of the eight main intelligence areas (linguistic, logical-mathematical, spatial, musical, kinesthetic, naturalist, interpersonal and intrapersonal) (Shearer, 1997). Each of the eight intelligences is assessed on a distinct scale and the questions under these scales can be considered as items[3]. While several researchers have attempted to develop scales to assess multiple intelligences, MIDAS is the only instrument endorsed by Gardner (D'souza, 2009). Each participant completed the questionnaire on paper and the researcher entered responses directly into the online MIDAS Scoring (OMS) System. All the participants completed the questionnaire in 20 to 30 minutes.

Shearer observes (2012) that, while traditional psychometric tests serve to mark the limits of the person's general intelligence, the MIDAS strives to describe the course and direction of intellectual growth and achievement potential in specific areas of skill for the eight intelligences. D'souza (2007:27) concurs that MIDAS can facilitate the researcher's understanding of individual differences among students "so that they can develop a strategy to intervene on the student's behalf".

4.4.3.2. Assessing design skill sets

This data collection method was implemented during Phase 1 (analysis and exploration of the problem) of the DBR process (Figure 5.1). To complete the first objective of the present study, the students' multiple intelligences were organised into four thematic design skill sets.

D'souza and others (2014) hypothesize that the design process could be supported in a variety of ways. One way is using the dual nature of design, especially in terms of rationality and skills, and how to essentially co-emerge it in a balanced and integrated manner (Bashier, 2016). However, in the process of identifying and examining skills, it is important to understand how designers communicate and propagate ideas in the design process. Design skills in this study are defined as the "diverse abilities intentionally used by designers to achieve desired goals in the specific environment" (D'souza & Chandrasekhara, 2014:5). D'souza and others (2014) refer to some skills as 'domain-specific', based on the attributes of the design domain; others are 'task-

[3] Item refers to a single question designed to elicit a response from the test-taker (D'souza, 2009).

specific', originating from the character of a given situation. Amabile and Khaire (2008) created a model for design skills that consisted of a 'domain-relative' experience, 'creativity-relevant' skill and motivation. On the one hand, students judge and synthesize collected data using their creativity-relevant skills and apply their technical knowledge based on their domain-relative experience; on the other hand, an educator should use motivation methods to initiate the design problem and to sustain the design process (Amabile & Pratt, 2016; Soliman, 2017). Thus, skills include both cognitive dispositions (for example, visualization skills) and physical enactments (for example, sketching skills).

To identify these design skills and to provide some coherence between design skills and multiple intelligences, D'souza (2009) suggests organizing design skills into four thematic design skill sets. The relationship of these design skill sets, with Gardner's multiple intelligences, was discussed in more detail in Chapter 2 under 2.3.3. See also Table 4.4.

Table 4.4: Relationship between Design skill set and MI

Design Skill Sets – D'souza	**MI – Gardner**
Emotional Skill Set (skills that involve emotions)	Intrapersonal Intelligence (personal emotions)
	Interpersonal Intelligence (another's emotions)
Sensory Skill Set (skills that involve senses)	Bodily-kinesthetic Intelligence (visualizing or experiencing the movement of the body in relation with the external environment)
	Naturalistic Intelligence (visualizing and experiencing nature and natural phenomena)
	Music/rhythmic Intelligence (recognizing or experiencing music/rhythms in relation with the external environment)
Logical Skill Set (logic–based skills)	Logical-mathematical Intelligence (working with numbers and geometry as well as solving problems)
	Spatial Intelligence (understanding symbols and identifying and designing formal strategies)
Ideational Skill Set (ideational/depictive skills)	Spatial Intelligence (the ability to perceive the visual world accurately and to transform and modify initial perceptions via mental imagery)

All the participants' multiple intelligences profiles (MIDAS scores) were clustered according to the four thematic design skill sets (section 5.2). The design domain requires a wide array of skill-sets, for example spatial visualization, logical thinking, emotional reflection, linguistic ability and interpersonal skills. Identifying the composite of skill sets for designers, according to D'souza and others (2014), could contribute to, firstly, making design learning more inclusive by understanding the differences in skills, weaknesses and strengths, and secondly to recognition of individual differences and approaches in design. This reduces the overt emphasis on graphic skills and form making with an increased focus on skills such as problem-solving, spatial sensitivity, and interpersonal and linguistic skills that will be more critical in dealing with real world design situations

4.4.3.3. Design Assignments

This data collection method was implemented during Phase 1 (Figure 5.1) and Phase 3 (Figure7.1) of the DBR process. The main objective of the design assignments was to verify to what extent the interventions had facilitated both the development of the participants' design skill sets and design knowledge transfer.

The design assignments were assessed according to the quality of design ideas and design solutions. A design idea was understood as a schematic or abstract representation of a design thought and a design solution was conceived as a concrete representation of a design output (Dorta, Kinayoglu & Boudhraâ, 2016; Gonçalves, Cardoso & Badke-Schaub, 2014; Oxman, 2008). The outcomes of each design assignment were evaluated on an achievement scale of 1[4] to 5. The design outputs, obtained from the various design assignments, were scored independently by two assessors, both experienced and SACLAP registered professional landscape architects. They were provided with a set of randomly ordered photocopies of the participants' sketches. The independent assessors evaluated the design assignments objectively, according to a predetermined rubric (see Addendum F), and the average of the assessment results were analysed for each task. The Cronbach Alpha tests of inter-observer reliability for different combinations of two assessors were used to indicate the reliability of the assessors' scores on each task.

Four different design theoretical concepts, elements and principles of design, relevant to the iterative cycle, were the subject of each design assignment. Each participant had to design two 20cm x 20cm compositions to illustrate the design principle. The participants could only use the three basic geometric shapes (circle, square and triangle) in their compositions and had to manipulate the shapes in terms of the number of shapes used, their sizes and positions to complete the assignment. Boucharen (2006) refers to the using of basic geometric shapes as a reduction of parameters, meaning that students are expected to solve a limited number of problems at any one time, before moving on to more complex problems. Each participant received the following: the brief for the design assignment (see Addendum G), an A3 template

[4] Level 1, the design idea/solution did not satisfy the design requirements, to level 5, the design idea/solution did satisfy the design requirements.

of pre-drawn primary shapes in various sizes to be used for the design assignment, scissors and glue.

The design assignment data collection method was concurrently implemented with the participatory action and learning projects and the unstructured focus group interviews.

4.4.3.4. Participatory Action and Learning Projects

This data collection method was implemented during Phase 1 (Figure 5.1) and Phase 3 (Figure7.1) of the DBR process. Participatory Action and Learning Projects (PAL) are defined by Appel, Buckingham, Jodoin and Roth (2012:5) as: "a growing family of approaches, tools, attitudes and behaviours to enable and empower people to present, share, analyse and enhance their knowledge of life and condition and to plan, act, monitor, evaluate, reflect and scale up community action." Furthermore, Carolissen and Bozalek (2017) highlight that PAL techniques facilitate dialogue and engagement among participants. The underlying principle behind the PAL methodology is to engage the full participation of people in the processes of learning about their needs and opportunities, and in the action required to address them. By empowering participants to creatively investigate issues of their concern, the approach challenges pre-existing biases and conceptions about participants' knowledge (Appel *et al.*, 2012).

The Participatory Action and Learning Projects (PAL) of this study consisted of a reflective drawing assignment and a verbal report on the drawing (video recording). According to Lawson (2004:11), in studying the process of verbalisation of design ideas, "we can see the development of design ideas not necessarily as creative 'leaps' but as 'bridges' between ideas". Each participant had to draw in iterative cycles one and two a Moodline diagram, and in iterative cycles three and four a Venn diagram. The circles in the diagrams indicated the resources a participant used during his/her design process for each design assignment, while the sizes of the circles were indicative of the extent of the contribution of each resource to the design process. This facilitated the extrapolation of additional information on how much each source had been used and trusted, and how the sources interrelated with one another. According to Appel and others (2012), these diagrams can be used to capture the spheres of influence in which information travels throughout a learning environment. Participants discussed knowledge sources from both within and outside of the learning environment, and judged their relative trustworthiness by means of a ranking tool that captures the opinions, beliefs, concerns or priorities of the participants. Participants were asked to identify a number of key issues pertaining to the research objective. From participants' ranking of the categories for their relative importance, impact and satisfaction, nuanced individual sentiments within the group were unveiled. The tool made it possible to elicit sensitive information from group members. As the act of ranking requires reflection and analysis, the exercise provokes group discussion (Appel *et al.*, 2012).

During each PAL project, all the participants were randomly assigned into four groups. Each group was assigned an independent facilitator. The facilitators facilitated all the PAL projects' individual voice report recordings. Voice reports were recorded with a digital video recorder and were transcribed verbatim. The video recorder only recorded each participant's PAL project, i.e. the diagram, and the participant's voice, not the face, in order to protect the participant's anonymity.

Qualitative data were obtained from the transcriptions of the PAL project individual participant video feedback recordings, and from the individual participant diagrams. A direct content analysis technique was implemented and the theoretical research framework (design skill set enhancement framework) provided guidance for the coding process (Hsieh & Shannon, 2005; Burnard, Gill, Stewart, Treasure & Chadwick, 2008). The purpose and main advantage of this directed approach was to validate and conceptually extend the theoretical research framework during each iterative cycle (Hsieh & Shannon, 2005). A summative approach was used to quantify certain words in the quotes, with the purpose of understanding the contextual use of the words and content. This quantification was not an attempt to infer meaning, but rather to explore usage (Hsieh & Shannon, 2005). Hesse-Biber and Leavy (2006) claim that this interactive process between the data and the theoretical research framework also effectively engages the researcher with the research material.

4.4.3.5. Unstructured focus group interviews

The unstructured focus group interview research method was implemented during Phase 1 (Figure 5.1) and Phase 3 (Figure7.1) of the DBR process. Focus group interviews with selected participants were used as a further data collection method in order to gain deeper insight into their opinions and experiences. Focus group interviews are unstructured discussions with groups of between six and eight participants, for the purpose of exploring a particular set of issues (Tong, Sainsbury & Craig, 2007). In this study, the interviews took place at the end of each iterative cycle. Simple random sampling was used to select the interviewees. The researcher conducted all the focus group interviews, which were recorded on a digital voice recorder and transcribed verbatim.

The focus group interview with the participants followed an unstructured, open-ended format and interviewees were probed for clarity on what had contributed to their design process. During focus group interviews, participants should be encouraged to interact with one another, but the facilitator must ensure that they answer questions individually (Hesse-Biber & Leavy, 2006). This interaction allows participants to explore and clarify individual and shared perspectives, but also enables respondents to build on the comments of others. Tremblay, Hevner and Berndt (2010) consider focus group interviews to be an appropriate evaluation technique for DBR projects, because they are sufficiently flexible to accommodate a wide range of design topics and domains.

Two types of focus group interviews in DBR are proposed in literature, namely exploratory focus groups that are used for the design and refinement of an artefact, and confirmatory focus groups that are used to explore or confirm the value of an artefact in an authentic setting (Tremblay *et al.*, 2010). Both these types of interviews were implemented in the study and proved to be advantageous for their confirmatory purpose, but also because additional contextually sensitive information, which did not surface from the other instruments, was gathered. The focus group interviews yielded rich data (see Chapter 7).

4.5 **Advancing credible assertions**

The development of a domain-specific instructional theory during the design experiment can be useful if it allows other researchers to build upon it when used in a different setting (Cobb *et al.*, 2003) The ultimate objective is to improve the learning trajectory of the student in any setting by testing and revising the conjectures. In a design experiment "it is reasonable to conceptualize the learning environment as an evolving ecology that does not exist independently of the lecturer and the students' activity but is constituted in the course of classroom interactions" (McWilliam, 2008:265). A retrospective analysis of the data set seeks to position participants' learning and the means by which it was supported in a solid theoretical context. The trustworthiness, repeatability and generalizability of the analysis are important aspects of design experiments.

Trustworthiness is concerned with the reasonableness and justifiability of inferences and assertions that result from a retrospective analysis (Cobb *et al.*, 2003). The credibility of the analysis depends on whether it is systematic and open to scrutiny and critique by others (Van den Akker *et al.*, 2013). All phases should therefore be well documented by means of voice and video-recordings, field notes and copies of the participants' drawings to substantiate the researcher's claims.

In this study the credibility of the data set was sought through thorough documentation of all interactions in the learning environment. The learning trajectories that were anticipated, as well as the actual trajectories, are all presented. These include all copies of student assessments, video recordings and transcriptions.

Repeatability refers to the potential of certain aspects of the learning process to be repeated in a different setting (Byrne, 2002). The idea is that these should be delineated during the retrospective analysis by highlighting the essential and the contingent aspects of the design (Bakker & Van Eerde, 2015). This is not advocating for realising the design in the same way in a different setting, but rather to create the possibility to adapt and modify an instructional sequence in a particular class (Anderson & Shattuck, 2012).

As stated earlier, DBR takes place in a natural setting as opposed to, for example, doing experimental research with a control group. Although it is context-specific, the instructional theory which is generated by formulating a hypothetical learning trajectory can be transferred to other contexts (Bakker & Van Eerde, 2015). All aspects of the design of this study have been carefully outlined within each iterative cycle of the teaching experiment, which enables transferability.

Generalizability of a study is strengthened when activities and events in the learning setting are framed as exemplars or prototypes. Cobb and others (2003) argue that the importance of generalizability is illustrated by the value of framing an experiment as a paradigmatic case of a broader class of phenomena. When accurate portrayals of the realities of social situations in their natural or conventional settings without manipulating variables or conditions are given, ecological validity occurs (Bakker & Van Eerde, 2015). Cobb and others (2003:12) contend that "design research aims for ecological validity" so that teachers in other settings may adapt the instructional sequence to their own classrooms. The notion of a 'thick description' is advocated by describing the participants and the teaching- learning situation in detail. Lodico and others (2006:35) emphasise this when they state that "thick descriptions involve a comprehensive description of the individual, the social context, and the characteristics of the community, morals, values, and the like". Repeated trials in different settings also enhance the ecological validity.

In this DBR study, the logic of process oriented explanations is invoked whereby the event sequence is the envisioned learning trajectory. This comprises the learning activities and shifts in students' reasoning. One needs to keep in mind that the "key point is to establish causality in the trajectory" (Reimann, 2011:43). In this study, causality was sought independently of generalizability by looking at the sequence of events and the consequences thereof.

4.6 **Ethical considerations**

Research that involves human participants raises unique and complex issues, and Wassenaar (2007:61) maintains that "research ethics should be a fundamental concern of all social science researchers in planning, designing, implementing, and reporting research with human participants". In South Africa, research ethics committees were established at all the large higher education institutions to promote ethical conduct and to further scientific inquiry. Therefore, clearance for this research was obtained from the Research Ethics Committee (Humanities) of Stellenbosch University and institutional permission from the Cape Peninsula University of Technology (refer to Addenda A and B).

Reimann (2011) argues that, because design research addresses student learning in a substantive manner, there will always be an element of teaching involved. In this study, the teacher/educator took on the role of researcher. It is essential for the researcher to be familiar with the proposed envisioned learning trajectory as well as the learning environment in which it must be enacted. It is through deeper analysis of and reflection on the pedagogical strategies that were adopted, that improvements in the learning environment could be brought about in order to develop the students' design skill sets.

The research design (i.e. DBR) by nature lend itself to a particularly participatory format. From the onset of the research process, the researcher was involved and collaborated with all the participants to ensure that they were treated with due respect. To protect the autonomy and welfare of the participants, a consent letter was obtained in which the purpose of the study, procedures, potential risks, discomforts, benefits, confidentiality, participation or right to withdraw were outlined (refer to Addendum C). All the participants were made aware that participation was voluntary and they could withdraw at any time without having to provide reasons and with no consequences to them. All information, including video recordings, will remain securely saved and no participant will at any stage be identified. The study did not involve any harmful physical activity or emotionally hazardous conduct, so no additional steps needed to be taken in this regard.

Furthermore, the information obtained during the course of the research that might have revealed the identity of a participant was treated as confidential. In this thesis, the research findings relating to specific individuals are reported in a way that protects the personal dignity and right to privacy of these participants. For instance, all responses to the measuring instruments were coded during analysis (e.g. 22 indicates the research number of a participant). Possible prejudice was reduced during analysis of the data of the focus group interviews, for example, by just voice recording the events.

According to Wiles, Prosser, Bagnoli, Clark, Davies, Holland and Renold (2008), two general professional guidelines identify visual methods as having specific ethical issues, i.e. the British Sociological Association guidelines and the Association of Social Anthropologists of the UK and Commonwealth guidelines. The issues identified relate to consent for the collection and dissemination of visual material and the importance of copyright clearance. All the photographs of the participants used in the thesis were anonymised (blurring of the faces) (Miller, 2018; Wiles *et al.*, 2008). The researcher communicated to participants how the photographs would be used and who would have contact with the images before beginning the study (Mannay, 2015). Each participant was informed that, until the moment of publication, the participant had the right to ask that his or her images not be used, shared, or distributed. If a participant request it, the photographs will be destroyed, deleted or returned to the participant (Bugos, Frasso, Fitzgerald, True, Adachi-mejia & Cannuscio, 2014). The participants were informed that the photographs used in this thesis would only be utilised for indicative purposes (Miller, 2018).

4.7 **Conclusion**

In this chapter the pragmatic paradigm, DBR, and the methodology used in the study were systematically outlined. The specific research context was explained and the iterative nature of the research process was detailed. In the concluding paragraphs, the focus fell on the quality and trustworthiness of the research process employed. In the next chapter, the analysis and exploration of the problem, the second part of Phase 1 of the DBR process, are presented.

Chapter 5 :
ANALYSIS AND EXPLORATION OF THE PROBLEM

5.1 Introduction

In the previous chapter, the research design and methodology were outlined and the cyclic process was detailed. The first objective of the present study was to investigate the required design skill sets for undergraduate design students and more specifically the design skill sets for Landscape Architecture studies nationally and internationally. The second objective was to analyse the current design skill sets of students registering for the Foundation Programme in the Diploma in Landscape Architecture at the Cape Peninsula University of Technology (CPUT), thus grounding this BDR study in relevant research, theory and practice (See Table 4.2).

In Chapter 5, the research findings relate to the second objective of this study and, in conjunction with Chapters 2, 3 and 4, represent Phase 1 of the DBR process (Figure 1.2). Figure 5.1 illustrates the positioning of Chapter 5 in Phase 1 of the DBR process.

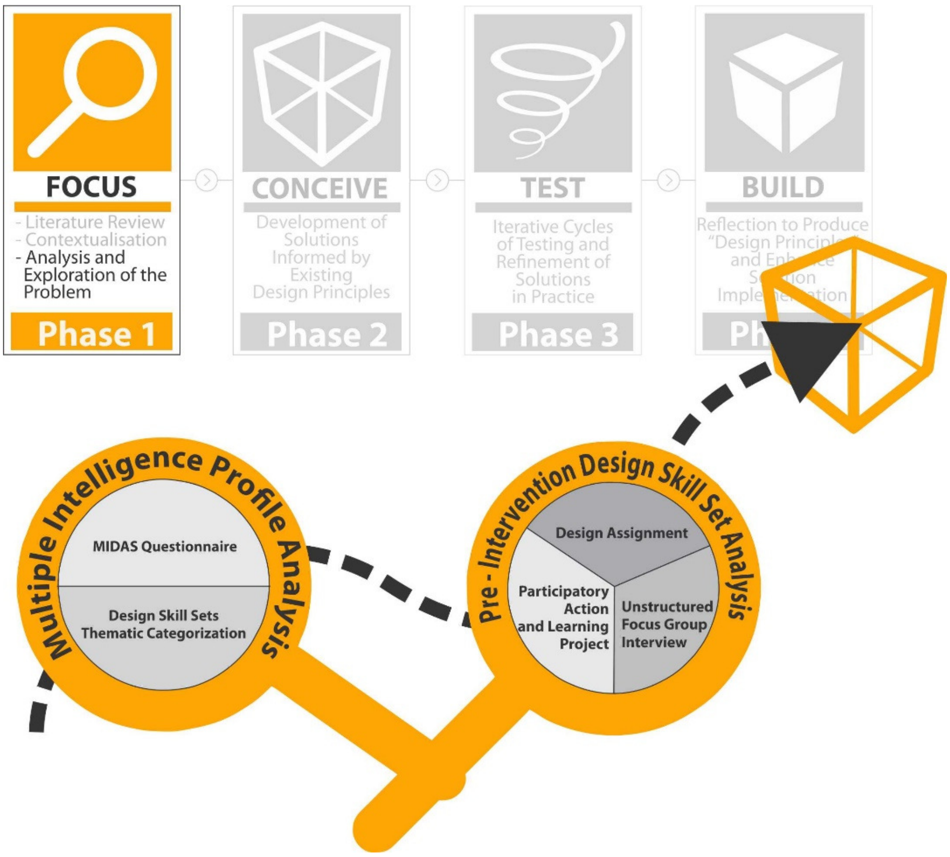

Figure 5.1: Analysis and exploration of the problem - positioning Phase 1

The Multiple Intelligence (MI) Survey indicated the MI profile of each of the participating students and their specific design skill sets. Their design skill sets were analysed and compared, not only based on a design assignment they completed, but also according to each participant's perspective of the design process.

5.2 Multiple Intelligence Profile Analysis

The Multiple Intelligence (MI) Survey was conducted right at the beginning of the research process in February 2017. The participants were the 2017 cohort (N=25) that enrolled for the Foundation Programme of the Diploma of Landscape Architecture at the Cape Peninsula University of Technology. In this study, all responses of the participants to the measuring instruments were coded and each of the participants received a confidential research number.[5] Only that number was used as reference to the participant. An objective third party did the allocation of the research numbers and the researcher was not involved in this process.

The research instrument was the Multiple Intelligence Development Assessment Scale (MIDAS) Questionnaire (See Addendum D). MIDAS was developed by Shearer (1997) and is intended to give a reasonable estimate of a person's intellectual disposition in each of Gardner's (1993) eight main intelligence areas (linguistic, logical-mathematical, spatial, musical, kinesthetic, naturalist, interpersonal and intrapersonal). According to Shearer (1997), each of Gardner's eight intelligences can be considered as a distinct scale and the questions under these scales can be considered as items[6]. Each participant completed the questionnaire on paper and the researcher entered responses directly into the online MIDAS Scoring (OMS) System. All the participants completed the questionnaire in 20 to 30 minutes.

A detailed table of the results obtained by the participants in the MIDAS test is presented in Addendum E. The MIDAS scores were standardised (Table 1.1); taken together, the mean percentage scores for the participants ranged from 64%[7] (for interpersonal intelligence) to 36% (for kinesthetic intelligence). The bar chart for the aggregate mean percentage scores for the various intelligences across the participant population is shown in Figure 5.2. Although there is a relatively notable difference (26%) between the highest score (interpersonal intelligence) and the lowest score (kinesthetic intelligence), there is still a consistency of mean percentage scores of intelligence across the population - demonstrating that the participants may be good at several different intelligences rather than only specialised in one or two forms.

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[5] Participants were numbered from 1 to 25

[6] Item refers to a single question designed to elicit a response from the test-taker (D'souza, 2009).

[7] Scores above 60% are considered high in MIDAS.

Table 5.1: Descriptive statistics of the MIDAS scales

Type	N	Minimum	Maximum	Mean	Standard Deviation
Interpersonal	24	22	88	64.25	15.22
Intrapersonal	24	25	79	57.83	12.59
Logical	24	22	76	49.54	13.32
Linguistic	24	21	88	47.83	15.77
Natural	24	8	72	46	17.77
Musical	24	14	86	43.29	19.72
Spatial	24	6	92	37.92	18.72
Kinesthetic	24	5	79	35.83	19.33

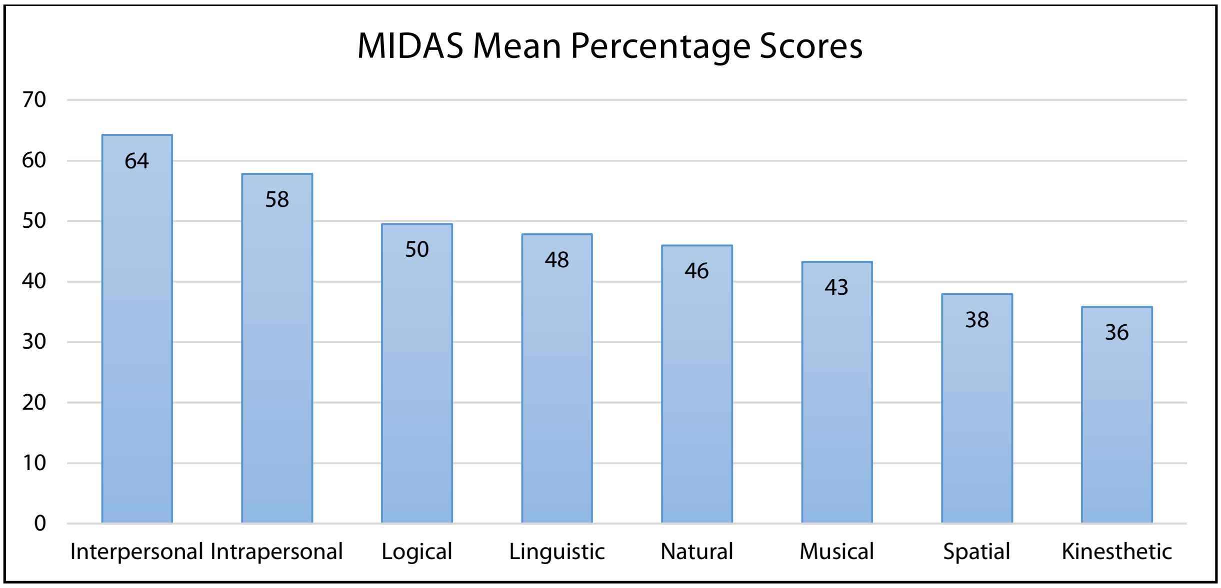


Figure 5.2: MIDAS mean percentage scores.

To analyse how the Landscape Architecture students participating in this study compare with other students in similar fields of study, empirical evidence from studies conducted by D'souza (2007) among Architecture students were used. D'souza's work indicated that the Architecture students' MIDAS scores ranged from 68% (for spatial intelligence) to 50% (for kinesthetic and musical intelligences) which is a notable difference to the results obtained in this study. Figure 5.3 combines the MIDAS scores of all the participants in this study with the scores of the Architecture Students (n=36) in the study done by D'souza (2007). According to D'souza (2007), designers use all intelligences in some threshold capacity and excel in domain specific intelligences. Figure 5.2 indicates not only that the participants' MI threshold capacity was lower, but also that there was a substantial difference (30%) between the domain specific, spatial intelligences (38%) and the Architecture students (68%).

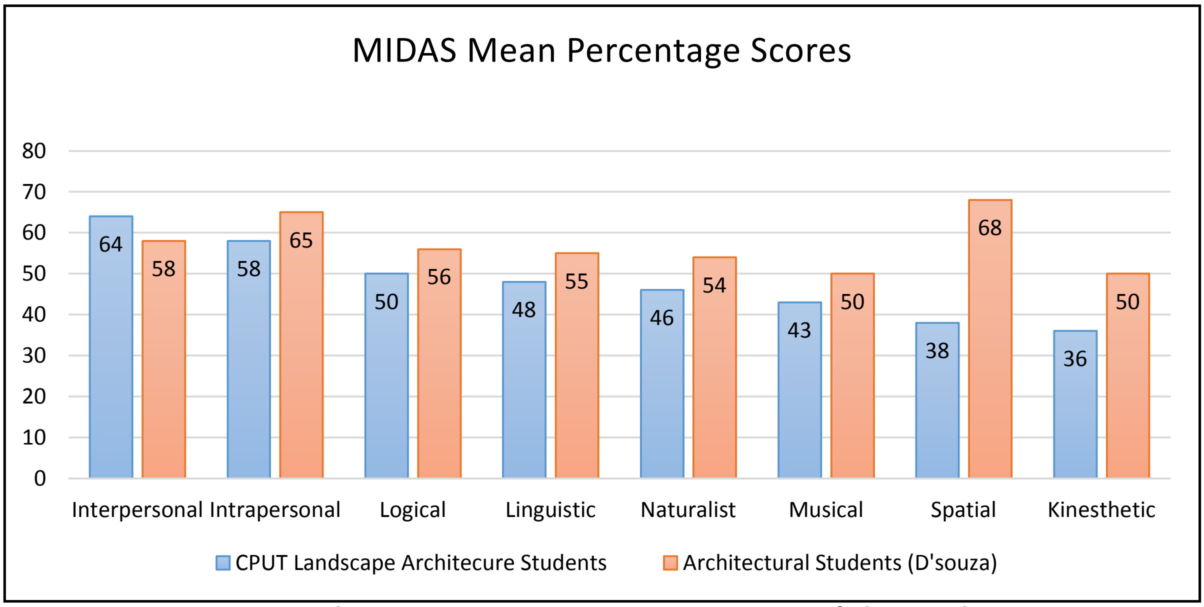


Figure 5.3: Comparison between mean percentage scores of the study participants and D'souza study architecture students.
Source: D'souza 2007

D'souza and others (2014) hypothesise that the design process could be supported in a variety of ways. One way is using the dual nature of design, especially in terms of rationality and skill-based, and how to essentially co-emerge design skill development in a balanced and integrated manner (Bashier, 2016; Le Masson, Hatchuel & Weil, 2016). To identify these design skills and to provide some coherence between design skills and multiple intelligences, D'souza (2009) suggested the organizing of design skills into four thematic sets, referred to as design skills sets (section 2.4.3) The themes include: skills that involve emotions (subjective and creative responses to design); skills that involve the senses (bodily experience in relation to the design world); skills that involve logic (rational and systematic approach to design); and ideational/depictive skills (visualization and representation of concepts, ideas and spaces). D'souza (2009) and Lawson (2005) both agree that the Ideational Skill set has the strongest agency to design, because it involves both the medium and the product of designing. Similarly, Casakin (2015) recognises it as the most influential activity since it largely affects the subsequent stages of the design process, including the design decisions being taken and the final outcome. Figure 5.4 not only indicates that the score for the Ideational Skill set was very low (40%), but also that three of the four skill sets sored below 50% - highlighting the mismatch or gap in design skill sets that the majority of the participants in this study experience and, therefore, how important it would be to develop these skill sets.

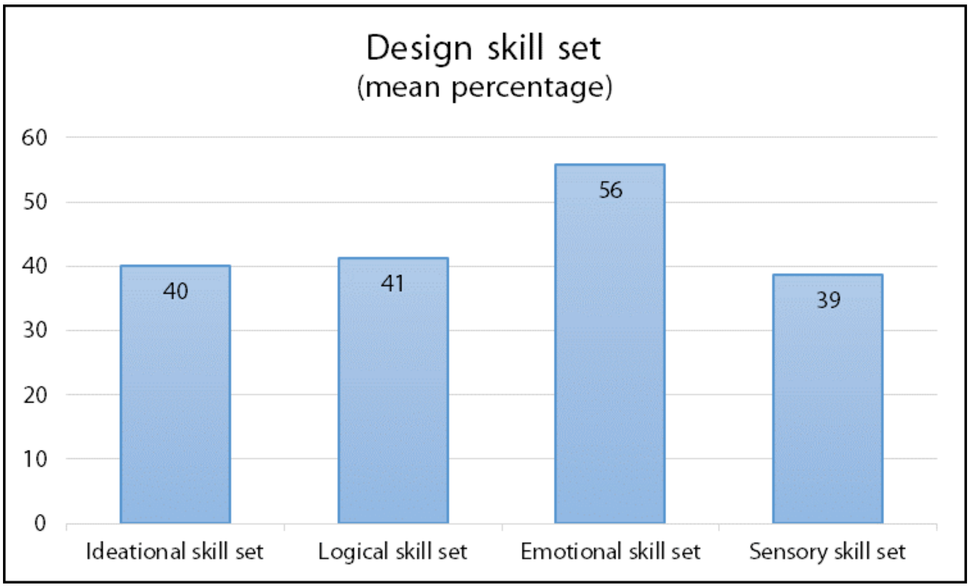


Figure 5.4: Design skill set mean percentage scores

5.3 **Pre-intervention design skill set analysis**

A pre-intervention evaluation of the design skill sets of each participant was conducted a week before the first intervention cycle was implemented. It consisted of three parts: design assignment 1, Participatory Action and Learning (PAL) project and an informal and unstructured interview (Figure 5.1).

Nineteen (86%) participants (out of the earlier 25) participated in this pre-intervention evaluation. Three participants had cancelled their studies and three participants were absent during the evaluation.

5.3.1 Data analysis

Table 5.2 presents the descriptive statistics of the results of design Assignment 1 and shows the distribution of the data. The results were obtained from the evaluation of each participant's design Assignment 1 Abstract Artefact by two independent assessors, according to a predetermined rubric (See Addendum F).

The qualitative data were obtained from the transcriptions of the Participatory Action and Learning (PAL) project's individual participant video feedback recordings, as well as the unstructured group interview and the PAL project's individual participant Moodline diagrams. The data were uploaded to the qualitative data analysis tool, ATLAS.ti, and coded. The mixed research methods and the indication of initial findings highlighted the integrative and contextual characteristics of this DBR study (Table 4.2).

5.3.2 Design Assignment 1

The design principle: 'emphasis' was the subject of design assignment 1. Each participant had to design two 20cm x 20cm compositions to illustrate design emphasis. The one composition had to show emphasis and the second had to demonstrate an absence of emphasis.

Each participant received the following: the brief for design assignment 1 (Addendum G), an A3 template of pre-drawn primary shapes in various sizes to be used for the design assignment, scissors and glue.

The outcomes of the design assignment 1 were evaluated on an achievement scale of 1[8] to 5. Two independent assessors evaluated the design assignments objectively and the agreement between assessors' marks was analysed for each task. The Cronbach Alpha test of inter-observer reliability (or consistency) for different combinations of two assessors indicated an excellent reliability of 0.93 between the two judges on each task.

A detailed table of the results obtained by the participants in design assignment 1, i.e. scientific investigation, is presented in Addendum H. The scores were calibrated (Table 5.2) in the aggregate; the average scores ranged from 1 (the design idea/solution did not satisfy the design requirements) to 4 (the design idea/solution did satisfy the design requirements). The mean score was 2 (possible but very little traces of emphasis in the composition, the design idea/solution did not satisfy the design requirements). The bar chart for the average scores of each participant is shown in Figure 5.5. The mean score of 2 (40%) indicates that half of the class scored below 40% and were not able to successfully complete this design assignment.

Table 5.2: Descriptive statistics for Design Assignment 1

Design Assignment 1 aggregate scores	
Mean	1.97
Standard Deviation	0.81
Minimum	1
Maximum	4

[8] Level 1, the design idea/solution did not satisfy the design requirements, to level 5, the design idea/solution did satisfy the design requirements.

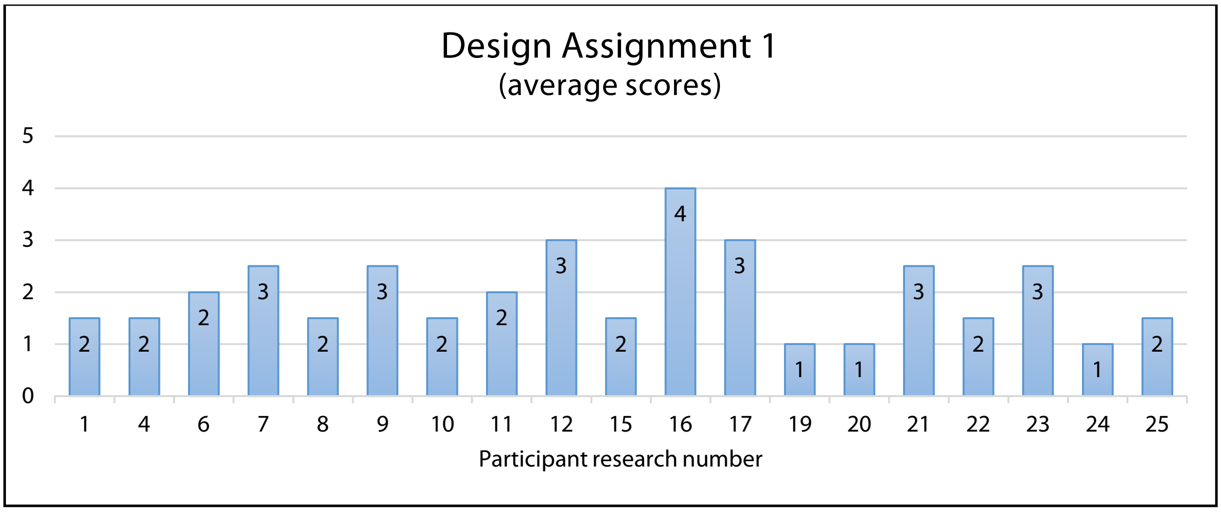


Figure 5.5: Average scores of each participant for Design Assignment 1

Figure 5.6 indicates a positive relationship between the participants' design assignment 1 average scores and their design skill set percentages.

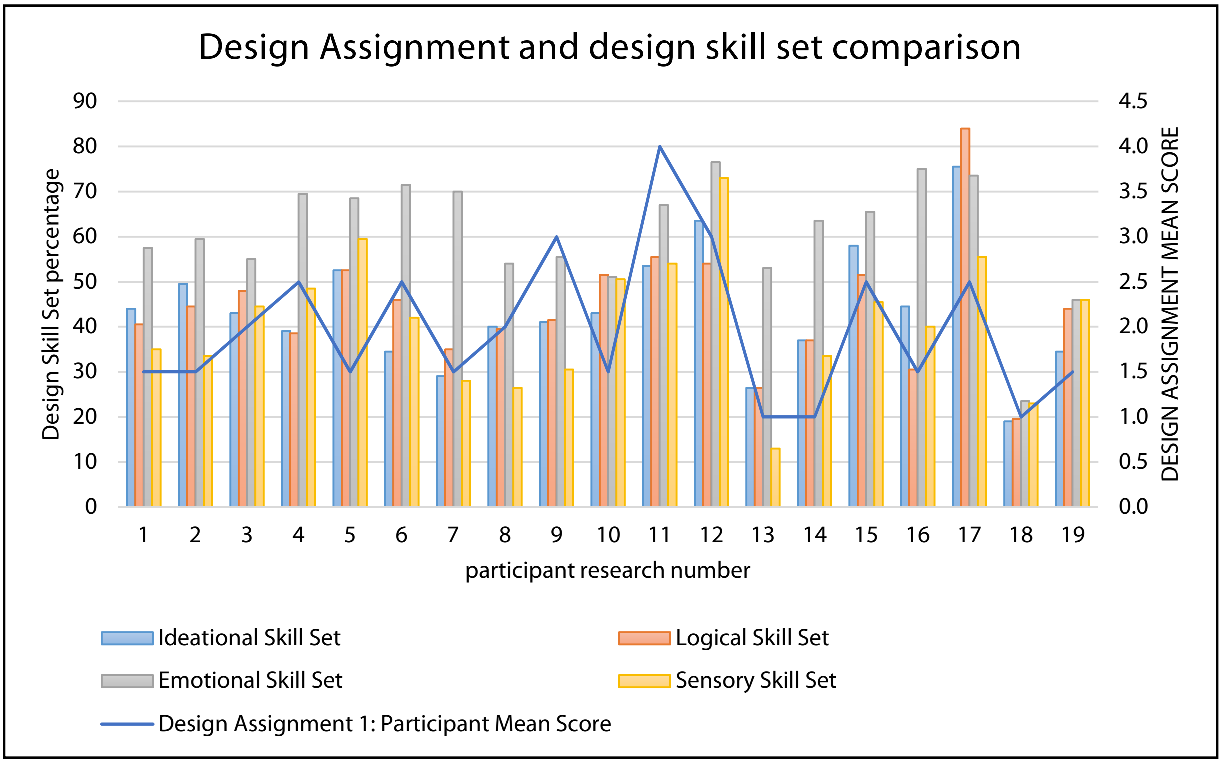


Figure 5.6: Comparison of Design Assignment 1 and design skill sets

This provided evidence to not only the mismatch or gap in the design skill sets that the majority of the participants were experiencing, but also highlighted the extent of their current abilities to resolve design related problems in a creative and satisfactory manner. This concurs with Casakin's (2015) notion that the generation of ideas requires the availability of domain specific knowledge and skills.

5.3.3 Design process perspectives and analysis

A Participatory Action and Learning (PAL) Assignment was subsequently implemented to investigate the participants' perspectives on Design Assignment 1. It consisted of two stages. During stage 1, the participants received an A3 page with colour pens and had to create a Moodline diagram that represented their emotional journey while executing the design assignment. In stage 2, the participants had to present their diagrams in a group.

Data of the participants' perspectives on the design assignment and how they experienced the design process, their perceptions of design, what they think it is, and how they experienced the process of design were collected. All of these qualitative data, as highlighted in 5.3.1, were analysed by means of directed content analysis coding that produced content specific quotes relating to each category.

The design process begins with a problem (i.e. design assignment 1)(Lin *et al.*, 2012) ; Runco & Chand, 1995) that is solved through the design process (Lin *et al.*, 2012), culminating in the designed output. This procedure, that has lately become more systematic, encourage novice designers to engage in the process of design rather than just the product of design (Rauth, Köppen, Jobst & Meinel, 2010). Lin and others (2012) suggest a three-stage process consisting of analysis, synthesis and evaluation. Lawson (2005) extends this three-stage model and suggest that the design process is a negotiation between the problem and the solution through analysis, synthesis (design) and evaluation. This negotiation between the problem and the solution signified a learning process, indicating the understanding of the design process.

The three-stage design process, as indicated in Table 5.3, was used as the evaluation tool that highlighted challenges in design education. The tool classified the participants' perspectives on their design process into the three stages of the design process.

Table 5.3: Design education challenges of Landscape Architecture students

Design Stage	Design Education Challenges	Participant quotes
Analysis Stage: -The accumulation and ordering of general information and information specifically related to the problem (Lawson, 2005), and -The investigation of the nature of the problem.	Design Domain Challenges: Unfamiliar to the design environment (created confusion and uncertainty)	*Okay basically during the design assignment, my mood was – I was actually very confused of what to do and how to go about it* (2)[9] *So at the beginning of the assignment I was really confused and I was really unsure of what I was supposed to do in class. I am not an artistic person. I don't know anything about designs and stuff* (20) *At the beginning I was like confused, as you can see. My line went down* [referring to the moodline]. *Here it shows, moving down. I didn't know nothing. My light bulb was off. No ideas popped in my head* (23) *I was excited at first then it dropped* [referring to the moodline]*… I was like so confused what I want to*

[9] Participant research number

		do, where I want to start, I was like, my mind was all over the place (24)
	Design Terminology Challenges: Limited exposure to basic design terminology.	*I never heard the word emphasis before* (22) *I couldn't understand the word emphasis* (13)
	Design Pedagogy Challenges: Verbal transfer of design concepts was ineffective.	*I was confused at what to do. And then when the lecturer explained I was still confused because I didn't know what the emphasis and design meant* (1) *So I was very confused but when the lecturer explained I was a bit, I was a bit certain but I'm not sure* (20)
	Design Assignment Challenges: Design assignment instructions was unclear.	*Oh, when I was given the design assignment I was really confused* (6) *But as I look at the instructions, I was confused in fact. So I really did not know what to do* (25) I*t was not that difficult. It's just that I didn't know exactly what I wanted to do* (7)
Synthesis/Design Stage: - Investigation of possible solutions of the problem, and - Development and refinement of a solution (Lawson, 2005).	Design Resources Challenges: Limited exposure to various design solutions restricted or halted the design process.	*So this is when it was explained again and then I started getting the hang of things. And then I just lost ideas there. I had no idea what to do* (1) *I started to think about the emphasis word and then I actually got a bit of knowledge about it but wasn't sure what it is* (9) *You will see here because I was confused I felt like my line should go down and then because I was just cutting* [the geometric shapes], *and then because my ideas came up so I was excited. I thought I should make it now like go up a bit and then down again because I was regretting it* (17)
	Design Skills Challenges: Underdeveloped skills to express design solutions, i.e. drawing skills	*Then when I started to draw I was a little bit bored because I do not know anything about drawing…along this process that I was doing I was a bit angry and grumpy again because I saw that my work was untidy and not giving any attraction.*.(19)
	Individual Creative Criticism Challenges: Perceptions of not being creative.	*I thought I knew what I was going to do and my idea kept on coming when I cut out the shapes and when I paste it on the paper, the ideas is on how to put them not the way that I thought. It was not the way that I have thought* (24)
	Abstract Concept Development Challenges: Unable to express the design concept in geometric shapes	*And then I decided to start with it. I was a little bit slowly and then during this process of drawing I felt confused because I really didn't know which shapes should I use to make something that will be, something that will show emphasis* (19) *because my project was – the shapes on my project were few so I regretted not posting many pictures as I could* (17) - *I actually knew what to do but wasn't sure which pictures to use. As you can see here I was distracted, you know* (9)
Evaluation Stage: - Test and evaluate the development of the solution, and	Design Articulation Challenges: Unable to fully express the whole design solution.	*I was like confused. I didn't know how to end off* (2) *things were clear enough even though I didn't finish* (6)

- Reflection on the design process.	Aesthetic Cognition Challenges: Unable to perceive logical and sensory qualities of visual elements, limiting artisanship and sculptural qualities of design.	*And then this is when I noticed that I had no clue of what I just did* (1) *Because it didn't know what to do. I had an idea. There wasn't something that inspired me to do* (21) *And after I thought I knew what to do because I saw the shapes and I thought I know, I can do this… I saw what I have done and I was not impressed at all* (12) *I had a clear picture of what we were about to do but it was not clear enough to understand* (6)

The aggregate quotes of the various design challenges during the Analysis Stage of the design process across the participant population are shown in Figure 5.7.

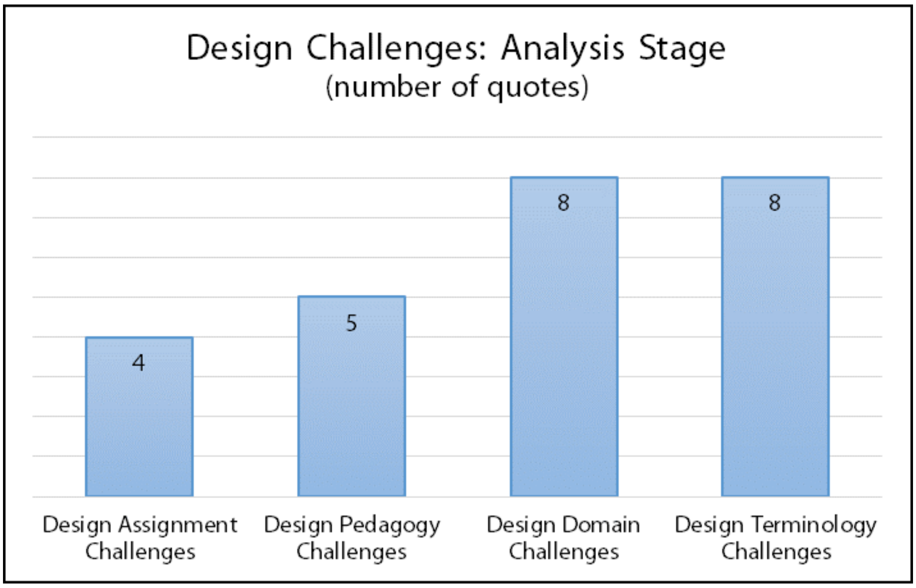


Figure 5.7: Design challenges during the design process analysis stage

Figure 5.7 shows that the highest number of quotes were registered for design domain (8) and design terminology challenges (8), highlighting the challenges of low design exposure and under-preparedness that the participants experienced in a design specific domain like Landscape Architecture.

In the design literature, according to Cash and Kreye (2018:3), these domain specific design challenges can be ascribed to a "perceived lack of knowledge" by the individual. It has also been referred to as 'epistemic uncertainty' (or uncertainty about what we know) (Ball & Christensen, 2009; Tracey & Hutchinson, 2016), describing a designer's metacognitive awareness of the limitations of their current knowledge or understanding (Ball, Onarheim & Christensen, 2010). Uncertainty is a characteristic feature of design work and has been described as primarily stemming from the unknown nature of the task outcome (Tracey & Hutchinson, 2016), and the unknown degree to which selected actions will fulfil the designer's goals (Xenakis & Arnellos, 2013). Uncertainty perception is related to a designer's past experience, attitudes and personal interpretation (Wiltschnig, Christensen & Ball, 2013). Uncertainty perception can thus differ between individual designers (Tracey & Hutchinson, 2016).

Professional identity has been conceptualized as the synthesis of knowledge, action and self, requiring not only the acquisition of expertise and skills, but also professional ways of being (Dall'Alba, 2009; Tovey, Bull & Osmond, 2010). From this perspective, students in design education programmes need to establish a sense of who they are becoming as a designer (and imagine who they might be) as the context for the development of the knowledge and behaviours that are manifested via the professional self (Dall'Alba, 2009). For design students, this means that foundational learning (i.e., what design is and what designers do, both in general and discipline-specific terms) should not be seen as an end in itself, but should instead be used to facilitate the establishment of a preliminary and personal sense of what it means to be a designer (Tracey & Hutchinson, 2016).

The aggregate quote of the various design challenges during the Synthesis/Design Stage of the design process across the participant population is shown in Figure 5.8.

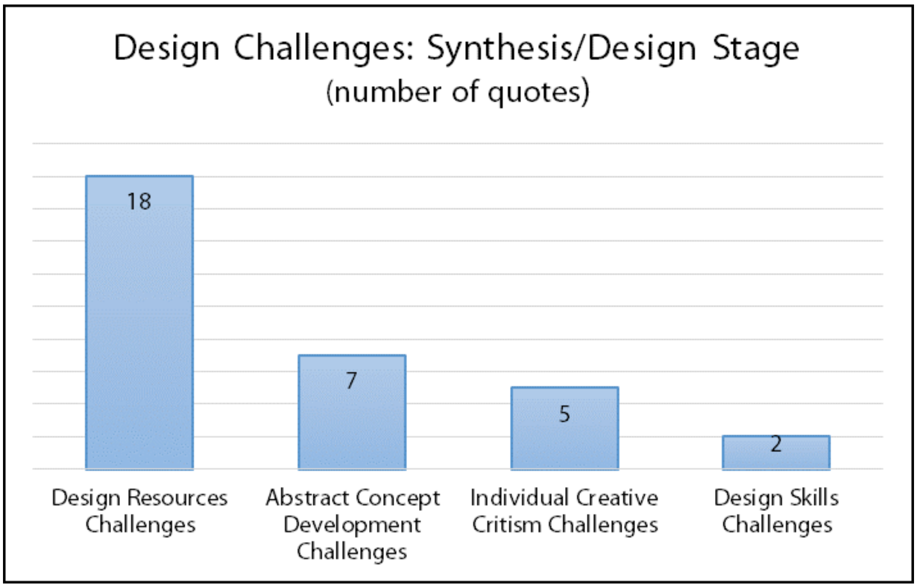


Figure 5.8: Design challenges during the design synthesis stage.

Figure 5.8 shows that a high number of quotes (18) was registered for design resource challenges, and secondly - demonstrated by the numbers of quotes on design domain and design terminology challenges (Figure 5.7) – that abstract concept development (7) and individual creative criticism (5) challenges were notable. This finding is indicative that the design process, like all creative activities, involves both rational aspects and other less easily explicable, non-rational aspects, such as the roles of intuition, imagination and personal insight (Cadle, 2009; Silvia, Beaty, Nusbaum, Eddington & Kwapil, 2014). This was emphasised by Casakin and Badke-Schaub (2015) concerning the support and acquisition of knowledge and development of expertise in design problem solving, mainly during the design phase of the design process.

This highlights the importance of not only creating authentic contextual teaching and learning environments that build resources for real life application and understanding of design problems (Akkuzu & Akçay, 2011), but also encouraging students to explore their own creative potential and self-confidence (Diliello, Houghton & Dawley, 2011; Plucker, 2011). This notion is encapsulated in the following words of a participant:

> *Design, you must think out of the box and you must allow yourself to not be, not to criticise yourself on whether something you're doing is wrong or right. Just allow yourself to create* (1).

The aggregate quotes of the two design challenges during the Evaluation Stage of the design process across the participant population are shown in Figure 5.9.

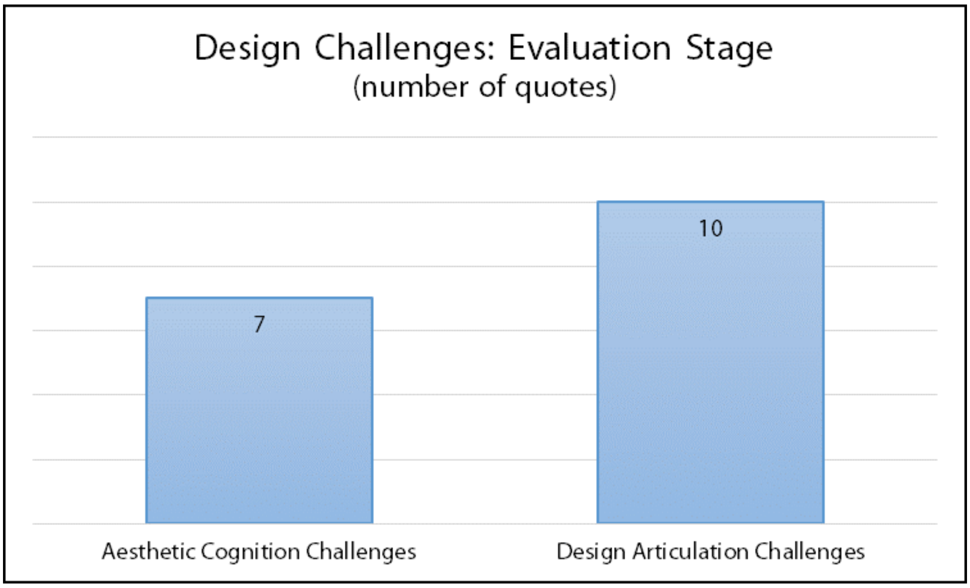


Figure 5.9: Design challenges during the design evaluation stage.

Both challenges, aesthetic cognition and design articulation, indicated a low level of analytical and divergent thinking skills (Martins & Wolf, 2015; Glăveanu, 2018), as well as design visualization and representation of concepts, ideas and spaces skills (D'souza, 2009). This resulted in the inability to produce design variations and alternatives to design problems.

According to Xenakis and others (2013), aesthetic cognition is related to 'known' types of experiences or impressions that we usually have as we interact with products. Specifically, some researchers propose models of aesthetic usability relating aesthetics to beauty and goodness (Rolls, 2017; Tractinsky, 1997). Others propose models relating aesthetic impressions to qualities (e.g. adorable, cool, strong, tragic, etc.) that could characterize a product or other types of experiences, such as enjoyment, fun, trustfulness, attractiveness, etc. that are not limited to beauty and goodness (Xenakis & Arnellos, 2013; Hartmann, Sutcliffe & De Angeli, 2007; Park, Choi & Kim, 2004). In addition, exploring further on how designers form and decide ways of interaction through products, the notion of design articulation affordances (considered as range of possibilities), proved to be a useful cognitive tool linking perception with action (Norman, 2013; Albrechtsen, Andersen, Bødker & Pejtersen, 2001). However, affordances are more than a cognitive element in the design process (Xenakis & Arnellos, 2013). The concept of affordance affect how designers think and how possibilities are perceived, thus influencing the selection of 'proper' functionality for artefacts (Hartmann *et al.*, 2007; Rolls, 2017). Both aesthetics and affordances are considered measures of design thinking, each one for the role it plays in the design process.

Runco, Acar and Cayirdag (2017) suggest that during this evaluation stage, the design thinking processes, idea generation, or the ideation is pertinent to divergent thinking, and the evaluation, which is associated with convergent/analytical thinking, exists as a part of ideation. Lin and others (2012) suggest that novice designers are not capable of switching their thinking modes between convergent/analytical and divergent thinking as frequently as practising designers. Therefore, reducing the frequency of repeating the creative thinking processes or sharing the burden of repeating the creative thinking processes with others, will help them practise alternating the thinking mode and thus simplifying the creative design process in which they need to go through while designing.

5.4 **Conclusion**

The levels of the design skill sets and MI scores, compared with the scores of the design assignment, highlighted the challenges of low design exposure and under-preparedness that the participants experienced. The evaluation of participants' perceptions on how they experienced the design process highlighted challenges in design education -grounding this study in a contextualised, real world setting (Table 4.2).

The following chapter addresses Phase 2 of the Design-Based Research Methodology. It will explore existing principles of teaching and learning in design education and develop the design skill set enhancement framework.

Chapter 6 : DEVELOPMENT OF A DESIGN SKILL SET ENHANCEMENT FRAMEWORK

6

6.1 Introduction

In the previous chapter, the second research objective, to analyse the current design skill sets of students registering for the Foundation Programme in the Diploma in Landscape Architecture at the CPUT, was completed. This chapter outlines the development of the design skill set enhancement framework through not only the exploration of existing principles of teaching and learning in design education, but also through the creation of both the design skill set modal agencies intervention and the design knowledge semiotic process. This chapter relates to Phase 2 of the DBR process (Figure 3.1). The third research objective (see section 1.3), namely the development of an intervention, is conceptualised.

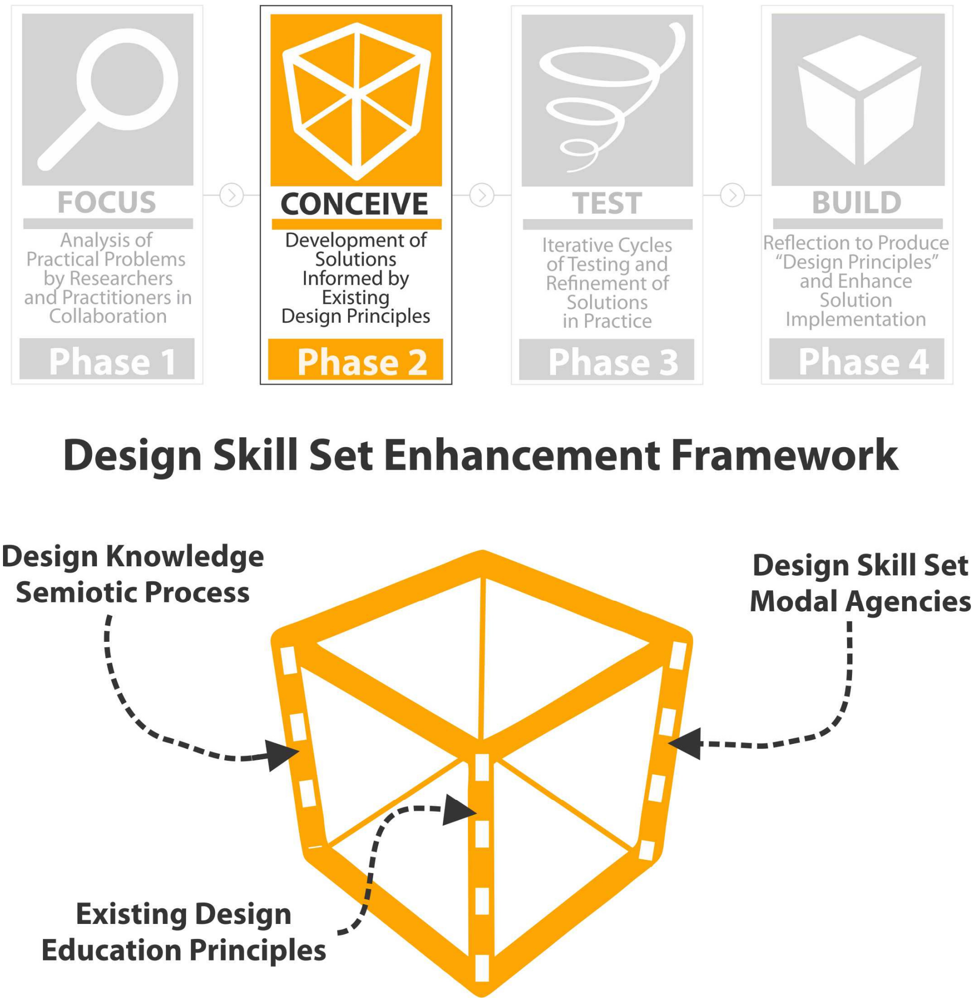


Figure 6.1: Conception of the Design Skill Set Enhancement Framework - positioning Phase 2

6.2 Existing Design Education principles

Design education must be a place that encourages individuality of interpretation and expression by means of creating an environment that allows for multiple solutions and different perspectives. These environments must address how students perceive themselves, how they construct and share knowledge, and how they understand and apply the design process to resolve and develop creative outcomes. Beghetto (2016) remarks that creative learning requires opportunities for students to engage with new and different perspectives and to have opportunities to share and receive feedback on their own unique perspectives. Conceding to that notion, Gajda, Beghetto and Karwowski (2017) recommend a blended teaching and learning approach that can simultaneously examine the more dynamic, qualitative and micro-level interactions amongst teachers and students. Herrington (2008) observed that traditional approaches in higher education have not resulted in appropriate learning outcomes. The challenge here lies in how effectively and substantively an alignment between higher education teaching and learning and the way learning in real-life settings occur, can be achieved (Herrington & Herrington, 2008).

The following sections highlight some of the influences that may affect a student-centered, realistic, and effective learning environment in design education.

6.2.1 Self-efficacy and environmental influences

Looking beyond the basic definitions of creativity, some creativity theorists have recently highlighted the importance of the individuals' self-perceptions of their own creative competency. Diliello and others (2011) state that an individual will experience creative expression when that person perceives that his/her work environment supports creativity. Research done by Gajda and others (2017) indicates the importance of affective support when it comes to behaviours associated with supporting creative learning, a type of 'emotional scaffolding'. This is also applicable to the learning environment, Plucker and others (2011) recommend that the learning environment must address the misconceptions of creativity, how students see themselves, other people and creativity as a construct. Thus, establishing an emotionally supportive and caring environment may provide the psychological safety necessary for students to take the risks required for creative learning and expression.

By enhancing the individual's self-efficacy (Plucker *et al.*, 2011), a creative self-confidence can be developed that would encourage the individual's willingness to participate in taking the necessary risks to be innovative. This self-perceived creativity, as defined by Zhou, Shin & Cannella (2008), is the degree to which people perceive that they have produced new and useful ideas. An individuals creativity is thus a conscious choice (Ford, 1996) as well as a combination of highly subjective experiences (Plucker *et al.*, 2011; Nakamura & Csikszentmihalyi, 2014; Diliello *et al.*, 2011). It is, however, also very important to note that when individuals perceive themselves as having creative potential, but do not perceive the ability to use this potential, they will be less likely to engage in creative behaviour (Diliello *et al.*, 2011; Tierney & Farmer, 2002; Ford, 1996).

Developing creative self-efficacy becomes an important principle in design education. Teaching and learning environments must facilitate the improvement of creative self-efficacy through not only focusing on the development creative skills sets but also facilitating opportunities for students to experience the freedom to explore their own creative potential and self-confidence.

6.2.2 Authentic contextual environment

Reeves (2004) theorises that, to establish a continual and complex learning environment that is purposeful and motivational, the context must be all-embracing. The context needs to incorporate not only a physical environment that will reflect the manner in which knowledge will be used, but also a large quantity of resources to facilitate the evaluation of different perspectives (Herrington & Herrington, 2008; Hill & Hannafin, 2001; Wilson, 1996; Gajda *et al.*, 2017).

Puckett (1993) observes that many courses missed this opportunity by removing ordinary, real life experiences from course materials. In many cases, generalized theoretical principles and skills were taught rather than situation specific capabilities. When learning and context are separated, knowledge itself is seen by students as the final product of education rather than the tool to be used to solve problems (Cole, 1990). Bereiter (1984) suggested that a distinction must be made between teaching about thinking and teaching thinking. He also noted that declarative knowledge be seen as a first step in gaining cognitive skills and needs to be followed up by a procedural stage in which knowledge becomes demonstrated in the actual behaviour of students. In the process of gaining cognitive skills and moving up to the procedural stage, context plays an important role in determining how a problem will be perceived, as well as providing support and strategies a student will use to solve it (Herrington, 1997).

As a possible model of instruction to address this process of knowledge development, Resnick (1987) proposes a model of 'bridging apprenticeships' that was designed to bridge the gap between theoretical learning in the classroom and the real life application of knowledge in the working environment. It was further developed into a theory of situated cognition or situated learning by Brown, Collins, Duguid & Seely (2007). It was the notion of acquiring knowledge and skills in contexts that reflects the way knowledge will be applied in real life situations (Brown *et al.*, 2007).

An example of a continual and complex learning environment in the context of this study is the studio environment. This studio environment can be used as a physical and conceptual tool in design education. Lawson (2005) points out that the studio is a process of learning by doing, especially by means of resolving design problems. In this process of doing and resolving problems, the studio is often assumed to mimic the office environment of professional designers. In contemporary design education courses, the studio environment is also used as a reflection tool for revision and application of assignments (Utaberta, Hassanpour, Handryant & Che Ani, 2013). The knowledge gathered through experience is valid in this environment and students are encouraged to not only be passive receivers of knowledge, but to actively acquire new knowledge through experimenting, creating and discovering (Boucharenc, 2006; Sausmarez, 1987).

Authentic contextual teaching and learning environments facilitate the process of knowledge development by bridging the gap between theoretical knowledge concepts and the real-life application and understanding of that theoretical knowledge. Incorporating a physical contextual environment will enhance situated learning through an active engagement between acquiring knowledge and skills and applying that in a practical contextual manner.

6.2.3 Collaborative learning environments

Collaboration, as defined by Roschelle and Teasly (1995), is an ongoing effort and mutual engagement of all the participants to collaboratively understand and maintain a shared conception of a problem through simultaneous and coordinated activities. Collaboration and the opportunity to collaboratively construct knowledge are seen as important elements in the construction of authentic creative learning environments (Herrington, 1997). It enhances the interaction between individual divergent practices and shared knowledge development learning activities (Puntambekar, 2006).

Creative learning environments must be extended beyond the concepts of physical learning spaces (Dudek, 2000) and include psychosocial and pedagogical elements (Davies, Jindal-Snape, Collier, Digby, Hay & Howe, 2013), as well as the influences of external environments and social interactions beyond these learning environments. Addison, Burgess, Steers and Trowel (2010) advocate that the extension of learning environments into the outdoor environment will foster creative development and that there is a positive correlation between these authentic creative environments and students' construction of knowledge, especially for lower-achieving students (Craft, Chappell & Twining, 2008; Whitebread, Coltman, Jameson & Lander, 2016; Freund & Holling, 2008). Davies and others (2013) suggest that with regard to the role of ownership of spaces, especially outdoors, time and space are seen as more owned by students. The 'indoor' classroom are perceived to be more individually focused, whereas 'outdoor' learning activities encourage more collaborative learning (Davies *et al.*, 2013).

Collaborative learning environments will support the co-construction of knowledge and mediates the creative learning process towards a shared understanding and development of domain specific knowledge and skills.

6.2.4 Analogical reasoning

Analogical reasoning is an effective cognitive mechanism that assists with the understanding of new knowledge by linking the 'unfamiliar' with the 'familiar' (Casakin & Van Timmeren, 2015; Tavsan, Tavsan & Sonmez, 2015). Analogies transfer relational knowledge from a known situation (usually referred to as source or base), to a situation that needs explanation (referred to as the target), where at least one of the related elements is not known (Moreno, Hernández, Yang, Otto, Hölttä-Otto, Linsey, Wood & Linden, 2014; Vosniadou & Ortony, 1989). Through the process of analogical mapping, a system of relations concerning the central properties of that knowledge is created and transferred from the base to the target situation. Identifying the similarity of possible relations between the target situation and the known relations in the source situation, leads to the creation of an analogy (Casakin & Goldschmidt, 1999). According to Goldschmidt and others (2006), the process of ideation, idea or concept generation, is possible due to the identification of visual clues which are supported by the interactive dialogue that designers establish between available external sources and internal representations. These external sources can be either visual or verbal stimuli, or both.

Visual stimuli or visual analogies assist with the definition of the problem, the clarification of ideas (Casakin & Van Timmeren, 2015), enhance the quality of design solutions (Gonçalves *et al.*, 2014), improve design knowledge and skills (Cai, Do & Zimring, 2010), and enhance creativity (Casakin, 2010). On the other hand, verbal stimuli or verbal analogies enhance originality and creativity of designs (Goldschmidt & Sever, 2011) and the generation of a large number of innovative ideas. Both types of analogies contribute to the originality and aesthetic value of the final design outcome (Casakin & Van Timmeren, 2015).

Analogical reasoning is important in the early stages of the design process, where the development of concepts and ideas affects the design decisions taken later (Goldschmidt & Smolkov, 2006).

6.2.5 Process of interpretation

The American philosopher C. S. Peirce (1998) developed a semiotic paradigm which describes how people construct an understanding of reality. This paradigm helps us understand how signs (such as words) acquire their meanings (become concepts) and how those meanings are subsequently 'updated'. Figure 6.2 illustrates Peirce's process of semiosis (Plowright, 2011).

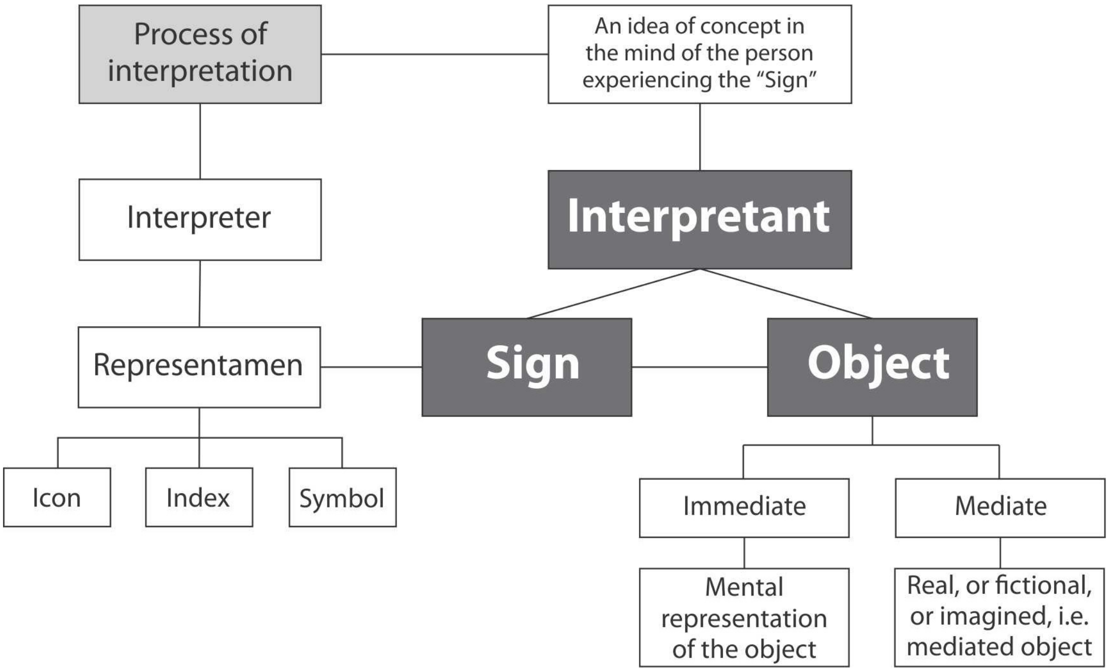


Figure 6.2: Peirce's process of semiosis
Source: Adapted from Plowright, 2011

The process of semiosis is based on three elements: a sign, an object, and an interpretant. Through the process of semiosis, the sign acquires meaning for the interpretant by associating that with the object. The interpretant allocates meaning to the sign when it comes into physical contact (sees, hears, tastes or smells) with it. The interpreter, through the interpretation process, develops an understanding of what the sign stands for and connects it to the object (Plowright, 2011).

Objects can be classified into two categories, namely mediate and immediate objects. Mediate objects are the actual real objects to which the sign refers. For instance, the word 'rose' refers to a flowery shrub with, for example, green leaves and red flowers. However, to know there is a link between the two, you would picture or think about this real shrub, the rose. This mental representation of the object is the immediate object (Plowright, 2011).

There are three types of signs (representamen): the icon, the index, and the symbol. An icon resembles or attempts to replicate the object by looking, sounding, tasting, smelling or feeling like it. A typical example of an icon is a photograph. A symbol has an arbitrary relationship with the object it represents. It does not look, sound, taste, smell or feel like the object. The link between the object and a symbol has to be learned. For example, the word 'rose' bears no resemblance to the real rose. Index or indexical sign has a causative link with the object, for example smoke is an index of fire, the indexical sign is caused directly by the object (Plowright, 2011).

According to Nadin (1988), design principles are semiotic in nature. To design means to structure systems of signs in such a way as to make the achievement of human goals possible: communication (as a form of social interaction), engineering (as a form of applied technical rationality) and business (as a form of shared efficiency).

6.2.6 Design Knowledge Semiotic Process

Design educators are constantly challenged by how to transfer design knowledge to students and how to stimulate new insights within them (Thoring & Mueller, 2012; Bashier, 2016; Lawson, 2005). The design knowledge semiotic process (DKSP), influenced by both the Analogical Reasoning process (sub-section 6.2.4) and transferring relational knowledge from 'familiar' to 'unfamiliar', and Peirce's (1932) semiotic paradigm, addresses this challenge by placing the focus on the semiotic meaning making process (Figure 6.2). It includes the three elements of semiosis (sign, interpretant and object), but expands on the interpretation process between the mediate object, the sign and the immediate object. The mediate object represents a theoretical concept in design knowledge, the sign represents the interpretation process the interpretant must go through, and the immediate object represents the transferred mental representation of the theoretical concept. Figure 6.3 provides a visual explanation of the elements and hierarchical levels of the DKSP, as well as the steps that indicate the procedural link between levels.

The steps are the practical activities that facilitate the creation of the cognitive links between each of these elements. These steps must be implemented in an authentic context specific environment (sub-section 6.2.2) to facilitate semiotic transference. In sub-section 6.3 these steps are facilitated by a set of four-design skill set modal agencies.

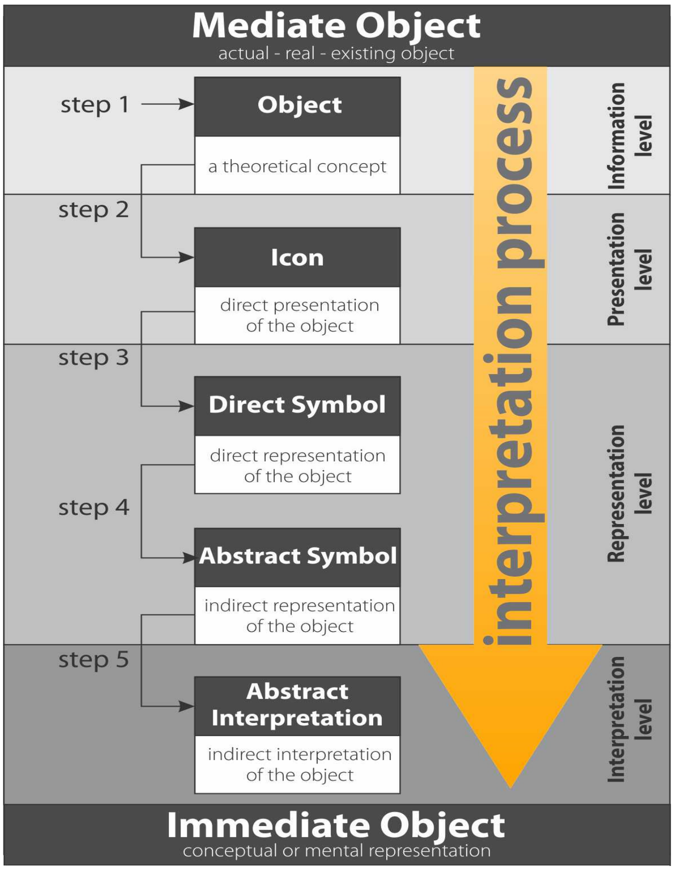


Figure 6.3: Design Knowledge Semiotic Process

The interpretation process, creating the sign, consists of the following elements:

- *Object:* a theoretical concept,
  for example, the basic design principle of symmetry.
- *Icon:* the direct presentation of the mediate object within a highly context-specific environment,
  for example[10], a plant leaf with a symmetrical vein structure.
- *Direct symbol:* the representation of the icon into a contextualized symbol within the same highly context-specific environment,
  for example, a sketch of that plant leaf.
- *Abstract symbol:* the representation of the contextualized symbol into a de-contextualized abstract symbol,
  for example, Mercedes Benz motor crest.
- *Abstract artefact:* the implementation of the abstract symbol into various contextual design requirements,
  for example, landscape plan of a courtyard that is symmetrical.

The four hierarchical levels of the interpretation process are the following:

- *Information Level*
  This is the least complex and occupies the lowest level of conceptual and methodological sophistication. The main function is holding the information until needed, i.e. a recording and storage of information.
- *Presentation Level*
  It functions on a denotative level of meaning, not going beyond the direct meaning of the sign. The main function in this phase is presenting the information to others through showing and describing.
- *Representation Level*
  It embodies a construction of understanding of information that is re-presented through the presentation or representation of selected ideas, information and knowledge in a specific contextual environment.
- *Interpretation Level*
  The process of creation and generation of design artefacts goes further than just drawing from informational, presentational and representational perspectives. It creates an interpretation or translation that implicitly or explicitly explains the meaning of that information through various contextual environments.

6.3 **Design Skill Set Modal Agencies**

Initially, Gardner's (1996) Multiple Intelligence (MI) theory was not only used to identify the eight relatively autonomous intelligences of each participant, but also to understand how an

[10] The context is the physical outdoor environment.

individual uses these intelligences in ways they take information in, retain and manipulate that information, and demonstrate their understanding of it to themselves and others. Supporting this process, Newfield (2011) suggests a move away from previous 'monomodal approaches' to teaching and learning, with their focus on language as the primary mode of learning and assessment towards the inclusion of more concrete, material, sensory and bodily practices. According to Newfield (2011), multimodality and multimodal pedagogies are founded upon the idea that meanings are made, disseminated and interpreted through many representational resources or modes – image, sound, music, gesture, space, colour, facial expression, body posture and movement (Stein, 2007; Newfield, 2011; Kress, 1997). Kress and Selander (2012) emphasise that modal agency acts as a prompt for someone who engages with it to interpret (it or) part of it in the light of her or his interest and of her or his semiotic resources.

The design skill set modal agencies create the environment that addresses the alignment (see Table 6.1) between the concepts of design skill sets, as discussed in Chapter 2 section 2.4, with existing design education principles. Table 6.1 highlights the required design skill sets in design education, follows the design knowledge semiotic process of 'meaning making' and creates the authentic and contextual design teaching and learning environments where these design skill sets can be enhanced (Figure 6.4).

Table 6.1: Design skill set developmental alignment

Required Design Skill Sets	Design Skill Set Modal Agencies	Existing Design Education Principles
Ideational Skills	Ideational Modal Agencies: 1. Theoretical content course material 2. Verbal Presentation 3. Direct Presentation 4. Indirect Representation	1. Authentic contextual environment 2. Collaborative learning environments 3. Analogical reasoning
Sensory Skills	Sensory Modal Principles 1. Natural Iconic Presentation 2. Kinesthetic Drawing 3. Kinesthetic Expression	1. Self-efficacy and environmental influences 2. Authentic contextual environment 3. Collaborative learning environments 4. Analogical reasoning
Logical Skills	Logical Modal Principles 1. Logical Iconic Presentation 2. Logical Symbolic Representation 3. Logical Interpretation	1. Authentic contextual environment 2. Collaborative learning environments
Emotional Skills	Emotional Modal Agencies 1. Group-Work 2. Friends/peers 3. Individual 4. Self-Study	1. Self-efficacy and environmental influences 2. Collaborative learning environments

The four modal agencies, indicated in Table 6.2, act as facilitators for the enhancement of the four design skill sets in a multimodal teaching and learning environment (Figure 6.4). Each modal agency correlates to a specific design skill set and each agency consists of specific meaning making or semiotic tools that support the enhancement of that specific design skill set. Figure 6.4 illustrates how each agency specific intervention also aligns to specific steps in the Design Knowledge Semiotic Process (DKSP) (cf. 6.3). Newfield (2011) suggests that using a shifting set of semiotic tools will facilitate the meaning making process.

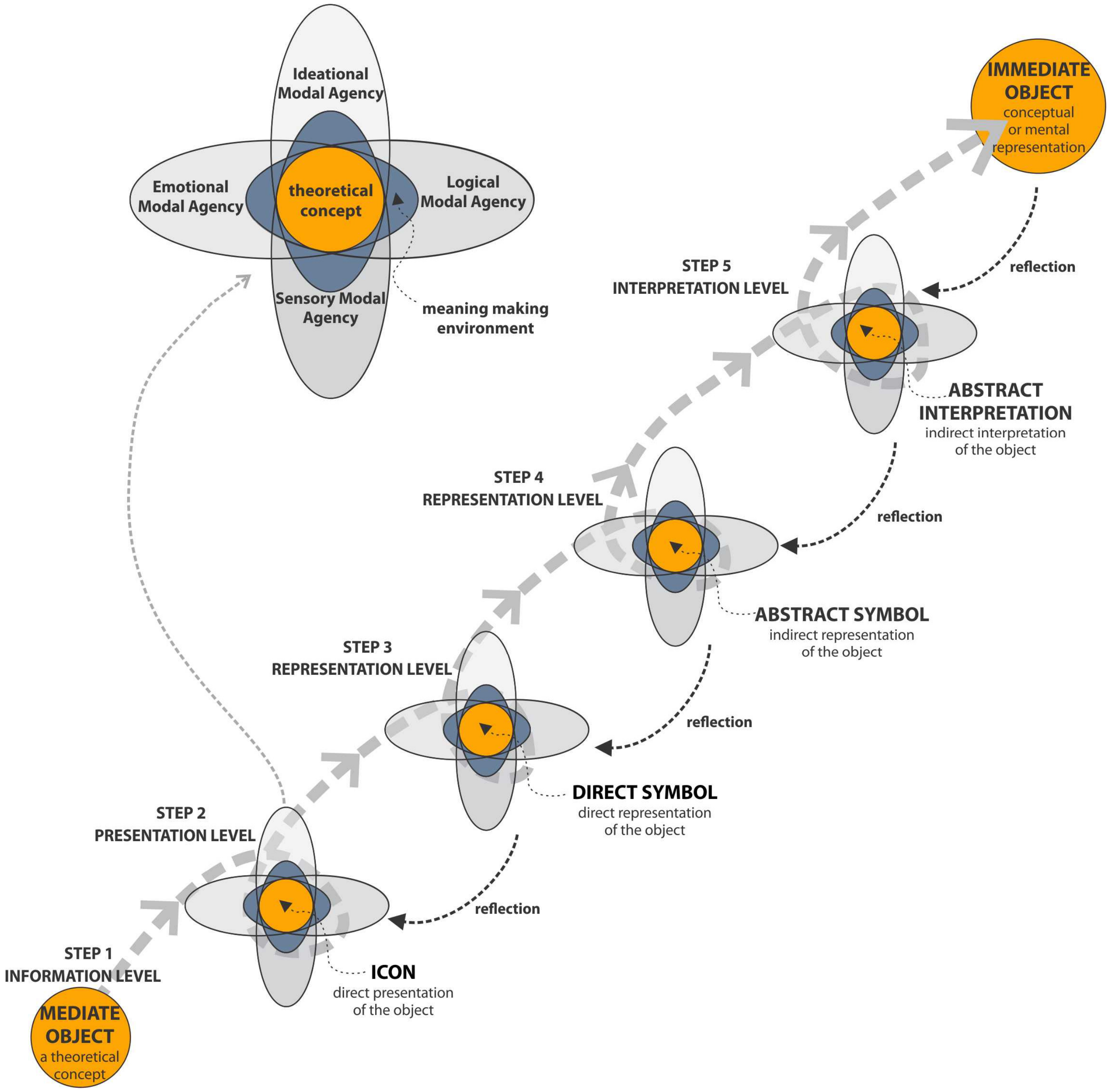


Figure 6.4: Framework for the modal agency meaning making process

In the process of making the modal agency specific semiotic tools, the design skill set attributes (D'souza, 2009), indicated in Table 2.3, are transcribed into modal entry points. Serematakis (1985:35) defines these entry points as senses, "meaning generating apparatuses" operating beyond consciousness and intention, inner states of feeling, relativized, contradicted or confirmed by embodied acts, gestures or sensory effects. The modal entry points have the potential to hold in tension access to dominant pedagogies while incorporating the rich variety of representational resources (Stein, 2007).

Table 6.2: Design skill set modal alignment

Design Skill Sets	Design Modal Agencies	Semiotic Tools
Ideational Design Skill Set	Ideational Modal Agency	Theoretical content course material
		Verbal presentation
		Direct presentation
		Indirect representation
Sensory Design Skill Set	Sensory Modal Agency	Natural iconic presentation
		Kinesthetic drawing
		Kinesthetic expression
Logical Design Skill Set	Logical Modal Agency	Logical iconic presentation
		Logical symbolic representation
		Logical interpretation
Emotional Design Skill Set	Emotional Modal Agency	Group-work
		Friends and peers discussion
		Individual reflection
		Self-study

The ideational design skill set attributes (Table 2.3) were transcribed into modal entry points and these entry points were combined into four ideational modal agency semiotic tools (aligned with DKSP):

- Ideational modal semiotic tool 1: theoretical content course material (a visual modal entry point) - creating a sensitivity to aesthetic cognition, design terminology and the identification and implementation of design precedents.
- Ideational modal semiotic tool 2: verbal presentation (a verbal modal entry point) – creating a sensitivity to the articulation of design ideas and using verbal tools such as narratives in design.
- Ideational modal semiotic tool 3: direct presentation (a spatial modal entry point) – creating sensitivity to the logical and sensory qualities of design and spatial transitions and scale.
- Ideational modal semiotic tool 4: indirect representation (visual and gestural entry point) – creating a sensitivity to design precedents, spatial chorography and spatial organization.

The sensory design skill set attributes (Table 2.3) were transcribed into modal entry points and these entry points were combined into three sensory modal agency semiotic tools (aligned with DKSP):

- Sensory modal semiotic tool 1: natural iconic presentation (spatial entry point) – developed an awareness to natural features, topography and materials.
- Sensory modal semiotic tool 2: kinesthetic drawing (gestural entry point) – developed a sensitivity to human scale and how space be modulated.
- Sensory modal semiotic tool 3: kinesthetic expression (gestural entry point) – developed a sensitivity to body movement in orientation and understanding human movement and time relationships.

The logical design skill set attributes (Table 2.3) were transcribed into modal entry points and these entry points were combined into three logical modal agency semiotic tools (aligned with DKSP):

- Logical modal semiotic tool 1: logical iconic presentation (spatial and visual entry points) – developed a sensitivity to understand symbols.
- Logical modal semiotic tool 2: logical symbolic representation (spatial and gestural entry points) – stimulate an ability to create and apply abstract symbols.
- Logical modal semiotic tool 3: logical interpretation (gestural entry point) – stimulate a sensitivity to understand abstract symbols and identifying and designing formal strategies.

The emotional design skill set attributes (Table 2.3) were transcribed into modal entry points and these entry points were combined into four emotional modal agency semiotic tools (aligned with DKSP):

- Emotional modal semiotic tool 1: group-work (verbal, gestural and social entry points) – creating a sensitivity to human behaviour, cultural norms and user needs.
- Emotional modal semiotic tool 2: friends/peers discussion (verbal and social entry points) – develop an ability for reflection and self-efficacy.
- Emotional modal semiotic tool 3: individual reflection(verbal and visual entry points) – create and awareness on personal knowledge and efficacy.
- Emotional modal semiotic tool 4: self-study (visual entry point) – develop a sensitivity to personal experiences and individual expression.

In the next section, the envisioned conceptual trajectory represents the anticipated concepts that students must learn and understand as well as the skills they must acquire through the four modal agencies intervention and specifically through modal agency meaning making process (Figure 6.4).

6.3.1 Ideational Modal Agency

The following ideational modal specific semiotic tools were used during the four iterative cycles in phase 3 of the DBR process (Chapter 7).

6.3.1.1. Theoretical content course material

At the beginning of each design intervention iterative cycle, the participants received theoretical content[11] in the form of printed course material.

Envisioned conceptual trajectory:

Theoretical content course material enabled the semiotic transference of the theoretical concepts (object), from visual signs in the form of the printed course material (mediate object) to the conceptualising or understanding of a theoretical concept (immediate object).

6.3.1.2. Verbal presentation

During each design intervention iterative cycle, the lecturer verbally introduced each of the theoretical concepts from the printed course material.

Envisioned conceptual trajectory:

The verbal presentation enabled and supported the semiotic transference of the theoretical concepts (object) through the verbal description of the printed course material (mediate object) to the conceptualising or understanding of a theoretical concept (immediate object).

6.3.1.3. Direct presentation

Each participant was requested to identify a visual example of a specific theoretical concept in a specific context and to present and discuss that visual example with the other participants in a group.

Envisioned conceptual trajectory:

The semiotic contextualisation of the theoretical concepts (mediate object) into a direct presentation (standing in) of a specific sign (stand for something else) which became an icon, creating a link between the theoretical concept and a context specific icon. This direct semiotic process is still in a specific context (environment/theme) and the icons are directly related to that specific context. Aligning authentic and collaborative learning environments with the contextualisation process.

[11] The theoretical content was based on the theory of basic design principles and a different principle was selected for each iterative cycle.

6.3.1.4. Indirect representation

Each participant was requested to create an artefact that indirectly represented the specific theoretical concept.

Envisioned conceptual trajectory:

The semiotic de-contextualisation of their understanding of the theoretical concepts, presented as an icon, into a direct or indirect representation of an abstract symbol. This indirect re-semiotisation process re-contextualised the theoretical concept into a non-specific context so that it can be applied/represented in various contexts. However, this principle requires that the other three Modal Agencies (Logical, Sensory, and Emotional) de-contextualise and modify the theoretical concept and represent it in other contexts. This incorporates both the self-efficacy and analogical reasoning design education principles.

6.3.2 Sensory Modal Agency

The following sensory modal specific semiotic tools were used during the four iterative cycles in phase 3 of the DBR process (Chapter 7):

6.3.2.1. Natural iconic presentation

This tool was applied in conjunction with direct presentation (Ideational Modal Agency) where each participant was requested to identify a visual example or icon of a specific theoretical concept in a specific context[12], and to present and discuss that visual example with the other participants in a group. The physical and natural environment created the context and facilitated the re-contextualisation of the theoretical content, while using that environment as the source for visualisation and presentation.

Envisioned conceptual trajectory:

Using the physical and natural environment as a resource that not only contributed to the semiotic contextualisation of their mental presentation of the theoretical concepts, but also provided natural iconic[13] examples for the creation of a direct presentation (standing in) of a specific sign (stand for something else) which sign became an icon. Creating a link between the theoretical concept and a context specific icon. This direct semiotic process is still in a specific context (environment/theme) and the icon is directly related to that specific contextual environment.

[12] Authentic and Collaborative Learning design education principles
[13] Iconic refers to the resemblance or imitation of the object (theoretical concept) by looking exactly like it (i.e. photograph) in nature.

6.3.2.2. Kinesthetic drawing

This modal specific semiotic tool was applied in conjunction with Indirect Representation (Ideational Modal Agency) and the participants had to visualise and physically create an artefact that indirectly re-presented the specific theoretical concept by means of human scale drawings, using the whole body to draw.

Envisioned conceptual trajectory:

Kinesthetic drawing facilitated the semiotic de-contextualisation of the theoretical concepts into an indirect or abstract representation of a specific symbol[14] by using the interaction between their bodies, the conceptual environment, and the physical environment. Drawing activities used the whole body, thus expressing the concept. Kinesthetic drawing must be the product of a sensory activity or process, not to be confused with visual perception or understanding of the sign.

6.3.2.3. Kinesthetic expression

This tool was applied in conjunction with the emotional group-work semiotic tool (Emotional Modal Agency) and indirect representation semiotic tool (Ideational Modal Agency). The participants had to visualise and physically create an artefact that indirectly represented a specific theoretical concept by means of creating human scale expressions, sculptures, and poses, incorporating the whole body as elements in it.

Envisioned conceptual trajectory:

Kinesthetic expression facilitated the semiotic de-contextualisation of the theoretical concepts into an indirect or abstract representation of a specific symbol[15] by using the interaction between their bodies, the conceptual environment, and the physical environment. Kinesthetic expression must also be seen as the product of a sensory activity or process and not to be confused with visual perception or understanding of the sign.

6.3.3 <u>Logical Modal Agency</u>

The following logical modal specific semiotic tools were used during the four iterative cycles in phase 3 of the DBR process (Chapter 7):

6.3.3.1. Logical iconic presentation

This semiotic tool was applied in conjunction with direct presentation tool (Ideational Modal Agency) and natural iconic presentation tool (Sensory Modal Agency). Each participant was

[14] That symbol that was created during the natural iconic presentation semiotic tool.
[15] That symbol that was created during the natural iconic presentation semiotic tool.

requested to identify a visual example or icon of a specific theoretical concept in a specific context[16], and to present and discuss that visual example with the other participants in a group.

Envisioned conceptual trajectory:

Supporting the semiotic contextualisation of their mental representation of the theoretical concepts (mediate object) into a direct presentation (standing in) of a specific sign (stand for something else) which sign became an icon. Creating a link between the theoretical concept and a context specific icon. This direct semiotic process is still in a specific context (environment/theme) and the icon is directly related to that specific contextual environment.

6.3.3.2. Logical symbolic representation

Each participant was requested to create two different abstract artefacts that indirectly represent specific theoretical concepts. The creation of the first artefact was in conjunction with the indirect representation tool (Ideational Modal Agency) process. During the creation of the second artefact, in conjunction with the logical interpretation process, the participants were introduced to additional abstract visual[17] and verbal symbols that acted as analogies to assist the design process.

Envisioned conceptual trajectory:

Assisting the semiotic re-contextualisation of a theoretical symbolic representamen into an abstract representation. This indirect re-semiotisation process re-contextualised the theoretical concept into a non-specific context so that it can be applied/represented in various contexts. However, this principle required that the other three Modal Agencies (Logical, Sensory, and Emotional) de-contextualise and modify the theoretical concepts and represent them in other different contexts.

6.3.3.3. Logical interpretation

The participants individually participated in a formal design assignment. They had to design an abstract artefact that consisted only out of variations of the three different primary shapes: squares, triangles and circles. They had to identify the design problem, interpret it, decontextualize the theoretical concepts and re-contextualise them into that specific problem context. Abstract visual and verbal analogies were provided to assist them with the design assignment. These abstract artefacts were a mixture of domain specific visual and verbal symbols and icons (i.e. relating to Landscape Architecture) as well as generic visual and verbal

[16] Authentic and Collaborative Learning design education principles.
[17] Analogical reasoning

representations of the concept. The interpretation or translation implicitly or explicitly explained the meaning of a theoretical concept.

Envisioned conceptual trajectory:

Completing a formal design assignment by the re-semiotisation and re-contextualising of various theoretical symbolic and analogical representaments into an abstract artefact. The analogical representaments facilitated the interpretational semiotic process of re-contextualising the theoretical concepts by means of a representational shift called analogical reasoning. The analogical reasoning methods that were used were Visual Analogy and Verbal Analogy.

6.3.4 Emotional Modal Agency

The following emotional modal specific semiotic tools were used during the four iterative cycles in phase 3 of the DBR process (Chapter 7):

6.3.4.1. Group-work

The participants took part in small and large group activities[18] to facilitate re-contextualisation of the theoretical concepts into direct and indirect representations. This interaction was limited to a specific context, theoretical concepts and time.

Envisioned conceptual trajectory:

Group-work created the environment and acted as a facilitating agent that assisted the semiotic processes of the theoretical concepts. It encouraged the participants to use the resources of 'others' when faced with insufficient information to complete a task.

6.3.4.2. Friends/peers discussion

The participants were encouraged to have informal discussions with friends and peers about the theoretical concepts.

Envisioned conceptual trajectory:

Requesting help/information from friends/peers also encourage using the resources of 'others' when faced with insufficient information to complete a task. The semiotic tool acts as a facilitating agent to assist the semiotic process of the theoretical concepts. This is however different from group-work, because of the closer interpersonal or individual link, and the facilitation role is not limited to the specific context or concept.

[18] Self-efficacy and Collaborative learning design education principles.

6.3.4.3. Individual reflection

This semiotic tool was applied in conjunction with the direct presentation tool (Ideational Modal Agency) and the natural iconic presentation tool (Sensory Modal Agency). Each participant was requested to identify, individually, a visual example or icon of a specific theoretical concept in a specific context, and to present and discuss that visual example with the other participants in their group.

Envisioned conceptual trajectory:

Encourage the reflection of the individuals' existing resources of knowledge and incorporate that to facilitate their own semiotic process. Combining existing personal knowledge with the theoretical concepts supports the semiotic contextualisation of their mental representation of the theoretical concepts.

6.3.4.4. Self-study

The participants were instructed to prepare or complete a section of the theoretical concepts on their own. Various self-study methods were implemented during the four iterative cycles and more detail on each method is provided in specific cycle descriptions.

Envisioned conceptual trajectory:

The individual was the facilitating agent[19] in the semiotic process of the theoretical concepts. He/she facilitated the semiotic transference of the theoretical concepts from visual signs in the form of printed notes and other material (mediate object) to the conceptualising or understanding of the theoretical concepts (immediate object).

6.4 **Conclusion**

In Chapter 6, the 'how to' of enhancing the design skill sets of students was the focus. In the first two phases of this DBR study, the research problem was analysed and then a solution in the form of an intervention was conceptualised, realising Objective 3: *To develop a framework to enhance the design skill sets of Landscape Architecture students* (section 1.3).

The design skill set enhancement framework consisted of a procedural structure, the design knowledge semiotic process, and a multimodal pedagogical concept, design skill set modal agencies. The initial construct of design skill set enhancement framework is still insufficiently detailed, which aligns with the interactive, iterative and flexible character of the DBR process that allows the researcher to amend and make deliberate changes to the framework when necessary (see section 4.4.1). Furthermore, the study indicates the pragmatic characteristic of

[19] Self-efficacy design education principle.

the DBR process (Table 4.2), which affirms the extent of how practice could expand and improve theory.

The following chapter addresses Phase 3 of the Design-Based Research methodology. It discusses and evaluates the implementation of this framework through four iterative cycles.

Chapter 7 : IMPLEMENTATION AND EVALUATION OF THE DESIGN SKILL SET FRAMEWORK

7

7.1 Introduction

Chapter 5 represented Phase 1 of the DBR process of analysing a practical problem, informed by both theory and practice. The development of the design solution (Phase 2) was addressed in Chapter 6, conceptually framing an effective intervention. This chapter coincides with Phase 3 of the DBR process, namely the implementation and testing of the intervention (Figure 7.1). The research design is characterised by four iterations of development, implementation and evaluation of the design skill set framework. Four different design theoretical concepts, elements and principles of design were taught during these four iterations, each iteration cycle a different theoretical concept. Each cycle started with a theoretical concept after which a two-stage design skill set modal intervention was implemented, followed by a reflection and refinement phase. A similar process was followed for all four cycles.

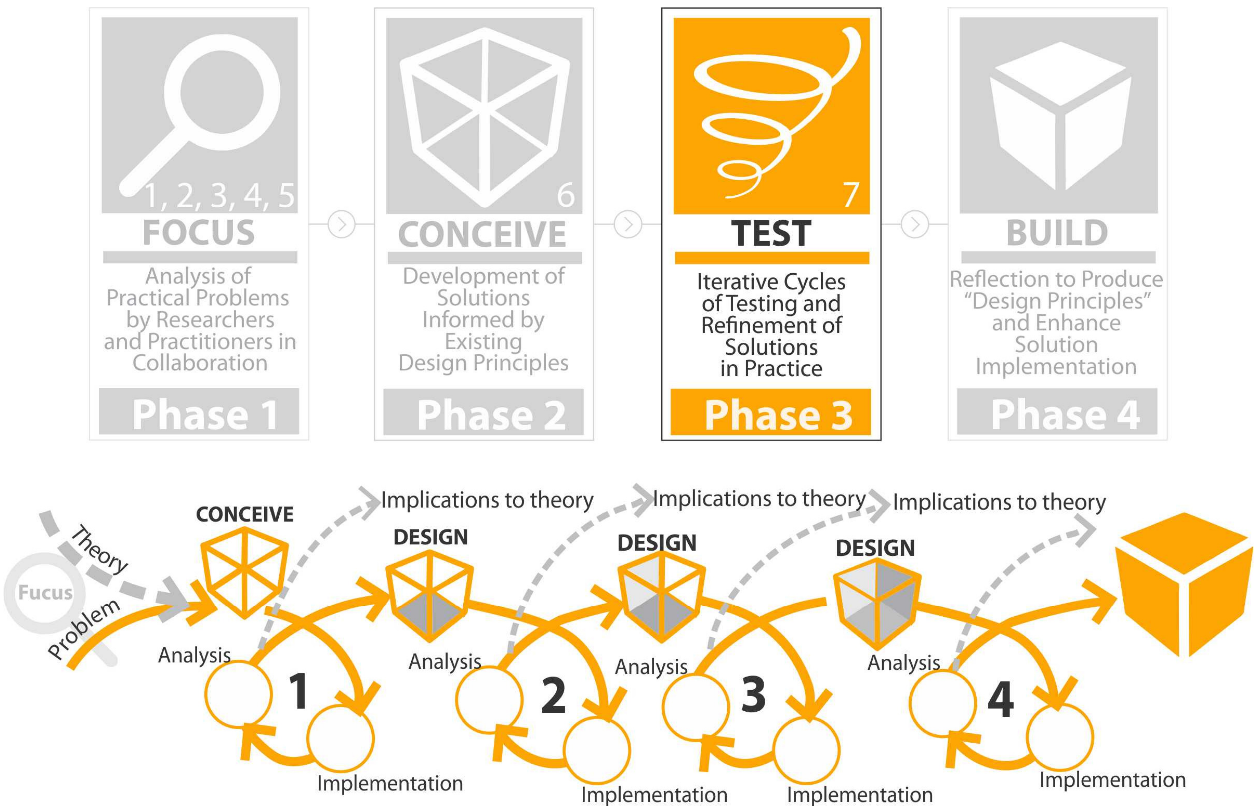


Figure 7.1: Implementation and evaluation of the Design Skill Set Enhancement Framework – positioning Phase 3

7.2 Theoretical concepts: elements and principles of design

The elements and principles of design are vital/essential to design students' education and contribute substantially to their design skill sets (Adams, 2013). These elements and principles are the building blocks upon which good design is based and the tools with which to create good design (Houghton, 2016; Çubukcu & Dündar, 2008; Brainard, 2006). According to Celik (2014), basic design elements are: point, line, direction, plane, volume, size, form, value, texture, and colour, and basic design principles are: emphasis, balance and symmetry, movement, scale, hierarchy and unity. For the purpose of this study, only four-design principles, namely emphasis, balance and symmetry, movement and scale were selected and separately implemented as the guiding theoretical concept in each iterative cycle.

7.3 Design skill set enhancement framework implementation stages

The implementation of the design skill set enhancement framework iterative cycles consisted of two stages (Figure 7.2). Stage 1 was implemented within a traditional studio classroom context for iterative cycle 1 and extended into an authentic, outdoor learning environment for iterative cycles 2, 3 and 4. It consisted of the implementation of the design skill set enhancement framework, specifically step 1 to step 4 of the modal agency meaning making process (Figure 6.4).

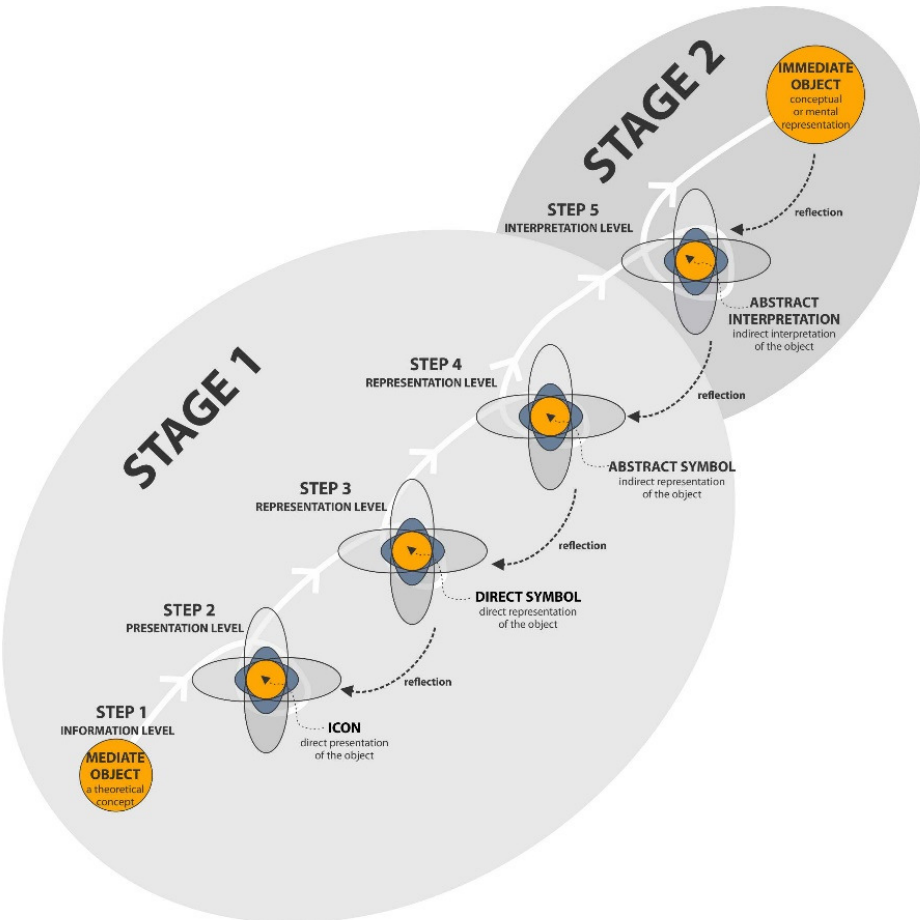


Figure 7.2: Design Skill Set Enhancement Framework implementation stages

Stage 2 of the intervention was implemented a week later in a traditional studio classroom context for iterative cycle 1 and 2, and was changed the next day for iterative cycles 3 and 4. During this stage, step 5 of the modal agency meaning making process was implemented (Figure 6.4). Stage 2 of the intervention consisted of three parts: a design assignment, a Participatory Action and Learning (PAL) project and an informal and unstructured interview (section 4.4.4). The iterative cycle specific design principle was the subject of each design assignment. The participants had to create two compositions (20cm x 20cm), each composition had to fulfil the requirements for that specific design brief (Addendum G).

The PAL project consisted of a reflective drawing assignment and a verbal report on the drawing (video recording). They had to draw a Moodline diagram for iterative cycle 1 and Venn diagrams for iterative cycles 2, 3 and 4, using circles to indicate the resources they used during their design process for the design assignment and the sizes of the circles was indicative of the resource contribution to their design process.

The methodology of stage 2 of the interventions stayed the same for all four iterative cycles, but the design principles differed for each design assignment.

7.4 Iterative cycle 1

The first iterative cycle (Phase 3 of the DBR) was implemented in February 2017 (Figure 7.3). Table 7.1 shows how meaning was transferred from the theoretical concept, for this iterative cycle 'emphasis' (section 7.4.1), through the modal agency meaning making process intervention (Figure 7.2).

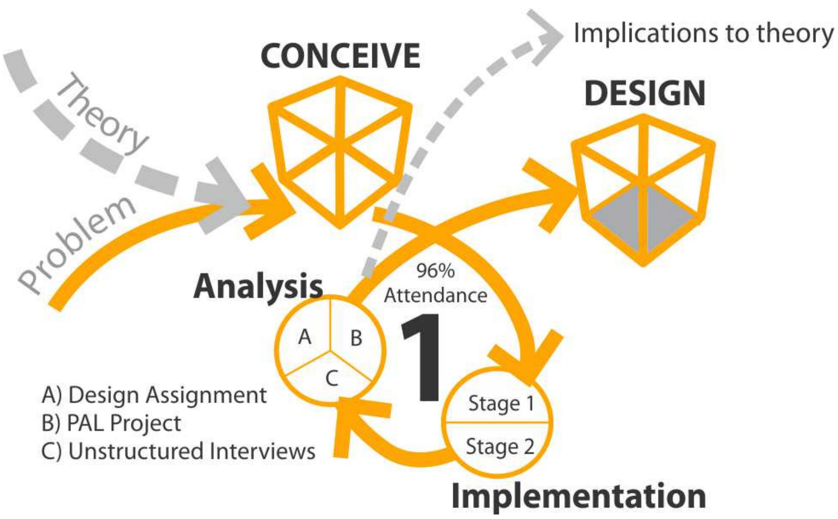


Figure 7.3: Iterative Cycle 1

7.4.1 Basic Design Principle: Emphasis

Emphasis in design is a way of attracting or controlling the attention of the observer (Saw, 2001), by creating a focal point and showing what is most important in a design (Tersiisky, 2004). The lesson focused on the principle of emphasis and divided it into the following concepts:

- Concept 1: Control of attention

  Attention can be controlled by contrast, placement and isolation.

- Concept 2: Dominance

  Dominance describes a situation where something dominates (is more important or more noticeable than its surroundings). Most designs communicate, tell a story or present a point of view. There is usually a focal point, a place where the action begins. The designer should be able to control what will be noticed first, what is dominant in an image, and where the viewer's attention will go from there.

- Concept 3: Subordination

  Minimizing or toning down other compositional elements in order to direct attention to the focal point.

Table 7.1: Iterative cycle 1 modal agency intervention – Stage 1

Theoretical Concept		DKSP Steps	Modal Agency and Semiotic Tools	Activity
Concept 1: Control of attention	Introduction to the concept of controlling attention	1 and 2	Emotional Modal Agency: - Group work	Each group had to create a composition with white, 9 x A4 papers, showing that one paper is more important that the others.
		2	Ideational Modal Agency: - Direct Presentation - Verbal Presentation	The lecturer also created a composition of 9xA4 white pages on the board. The class discussed the following: - what page did you see first? - why? - what will happen if one page is removed? - what happens if the colour of one page changed?
		4	Sensory Modal Agency: - Kinesthetic Expression	The group members must stand in a line and one member must be emphasised. The other participants must be able to identify that member (Figure 7.4).
	Methods: Contrast (Colour, size and shape)	1, 2 and 3	Ideational Modal Agency: - Direct Presentation - Verbal Presentation Emotional Modal Agency: - Group-work	Show pictures and drawings of the effect of contrast in creating emphasis in design; must have colour, size and shape in it separately - No annotations! Each group had to identify and discuss: - what was emphasis element, - what method was used, and - was that effective.
		4	Sensory Modal Agency: - Kinesthetic Expression	Build artefacts out of Lego that represents the different methods of contrast (Figure 7.5).

			Emotional Modal Agency: - Individual Ideational Modal Agency: - Indirect Presentation	
	Methods: Placement (Format, proximity, similarity and isolation	1, 2 and 3	Ideational Modal Agency: - Direct Presentation - Verbal Presentation Emotional Modal Agency: - Group-work	Show pictures and drawings of the effect of position in creating emphasis in design; must have placement, proximity, similarity and isolation in it separately - No annotations! Each group had to identify and discuss: - what was emphasis element, - what method was used, and - was that effective.
		4	Sensory Modal Agency: - Kinesthetic Expression Emotional Modal Agency: - Group-work	Create pose with all the group members on the effect of placement in creating emphasis (Figure 7.6).
		4	Sensory Modal Agency: - Kinesthetic Drawing Emotional Modal Agency: - Individual	Individually draw on an A1 paper four different ways to create emphasis, using placement (Figure 7.8).
<u>Concept 2:</u> Dominance		1, 2 and 3	Ideational Modal Agency: - Verbal Presentation - Direct Presentation	Show pictures and drawings of the dominance and focus points. Each group had to identify and discuss: - what was dominant, - reason, and - was that effective.
		2 and 3	Emotional Modal Agency: - Individual - Natural Iconic Presentation Logical Modal Agency: - Logical Symbolic Representation	Each participant had to think of elements in their surrounding environment that are dominant; write down the words on a card, and stick it on the wall.
		4	Sensory Modal Principle: - Kinesthetic Expression Emotional Modal Agency: - Group-work	Create a group pose that illustrates dominance (Figure 7.7).
<u>Concept 3:</u> Subordination		1, 2 and 3	Ideational Modal Agency: - Verbal Presentation - Direct Presentation	Show pictures and drawings of subordination, effective and ineffective ones. Each group had to identify and discuss: - indicate elements lower in ranking - was it effective?
		3	Emotional Modal Agency: - Group-work Ideational Modal Agency - Verbal Presentation	In the group, identify and discuss how dominance and subordination will work in your residence.
		4	Emotional Modal Agency: - Group-work Sensory Modal Agency: - Kinesthetic Expression Ideational Modal Agency: - Natural Iconic Presentation	Each group had to create a short play to convey how dominance and subordination will work in the animal kingdom (3 min).

Figure 7.4**:** Group activity illustrating the concept of emphasis.
Source: Author

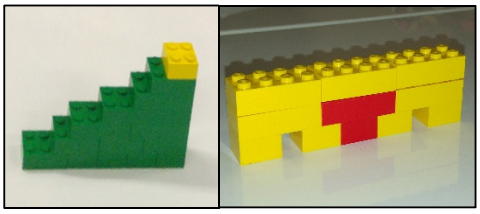


Figure 7.5**:** Lego artefacts that represented the different methods of contrast.
Source: Author

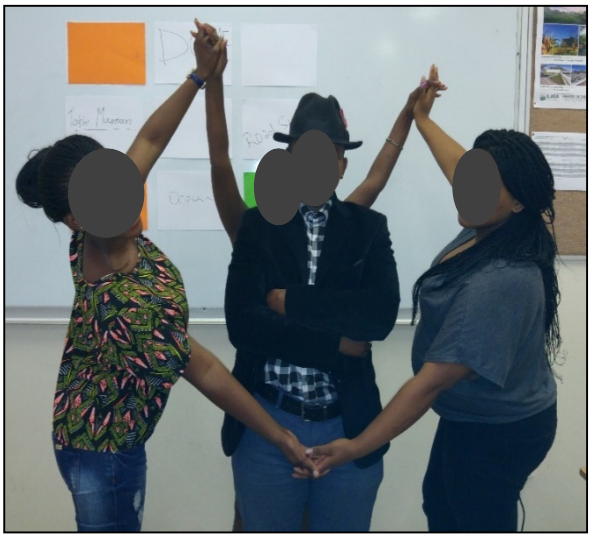


Figure 7.6**:** Group activity illustrating emphasis through placement.
Source: Author

Figure 7.7: Group activity illustrating dominance.
Source: Author

Figure 7.8**:** Individual drawing illustrating emphasis through isolation.
Source: Author

7.4.2 Qualitative analysis of Design Assignment 2 (Stage 2)

The outcome of the design assignment 2 was evaluated on an achievement scale of 1[20] to 5 (see design assessment rubric in Addendum F). Two independent assessors evaluated the design assignments objectively and the average of the assessment results was analysed for each task. The Cronbach Alpha tests of inter-observer reliability for different combinations of two assessors indicated an excellent reliability of 0.93 between the two assessors on each task.

A detailed table of the results obtained by the participants in design assignment 2 is presented in Addendum H. The scores were standardised (Table 7.2) in the aggregate, and the average percentage scores for the participants ranged from 2.5 (the design idea/solution did satisfy the design requirements) to 4.5 (the design idea/solution did satisfy the design requirements). The mean score was 3 (one or both compositions indicated emphasis, but there was either no difference in the methods used, wrong, or no indication of the methods used; the design idea/solution did satisfy the design requirements). The bar chart for the average scores of each participant is shown in Figure 7.10. The mean score of 3 (score level of 60%) indicates that half of the participants scored 60% and above, with the highest number of participants (12) in the score frequency interval between 3.0 and 3.4. (Figure 7.9). The minimum score of 2.5 (score level of 50%) of 3 participants highlighted that all the participants were able to apply emphasis, but still struggled to successfully complete all the requirements of the assignment.

Table 7.2: Descriptive statistics for Design Assignment 2

Design Assignment 2 aggregate scores	
Mean	3.17
Standard Deviation	0.51
Minimum	2.5
Maximum	4.5

[20] Level 1, the design idea/solution did not satisfy the design requirements, level 5, the design idea/solution did satisfy the design requirements.

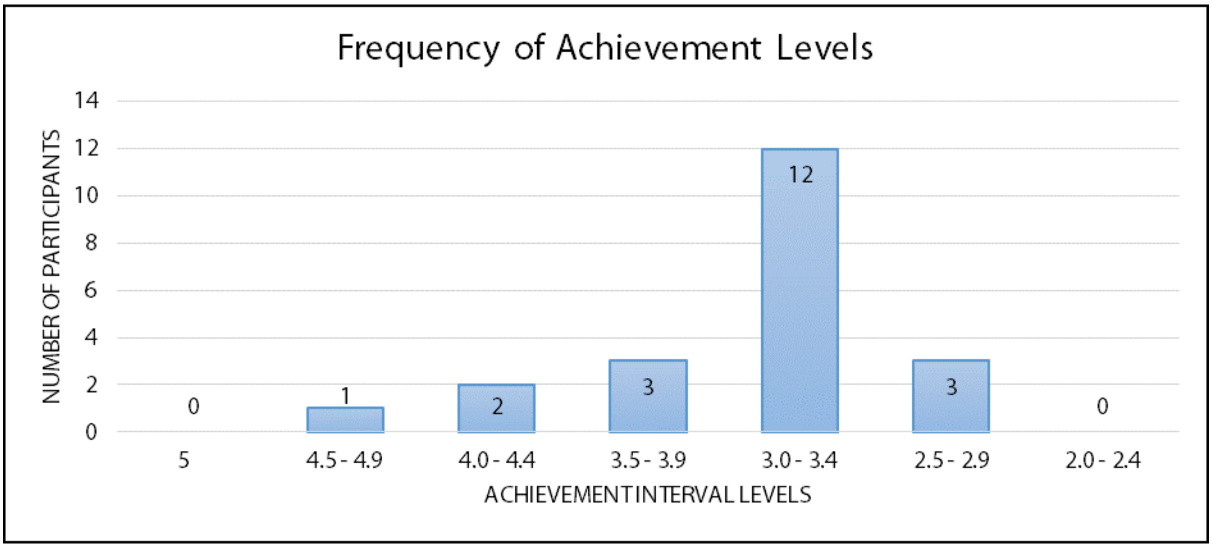


Figure 7.9: Frequency of achievement levels in Design Assignment 2 (Iterative Cycle 1)

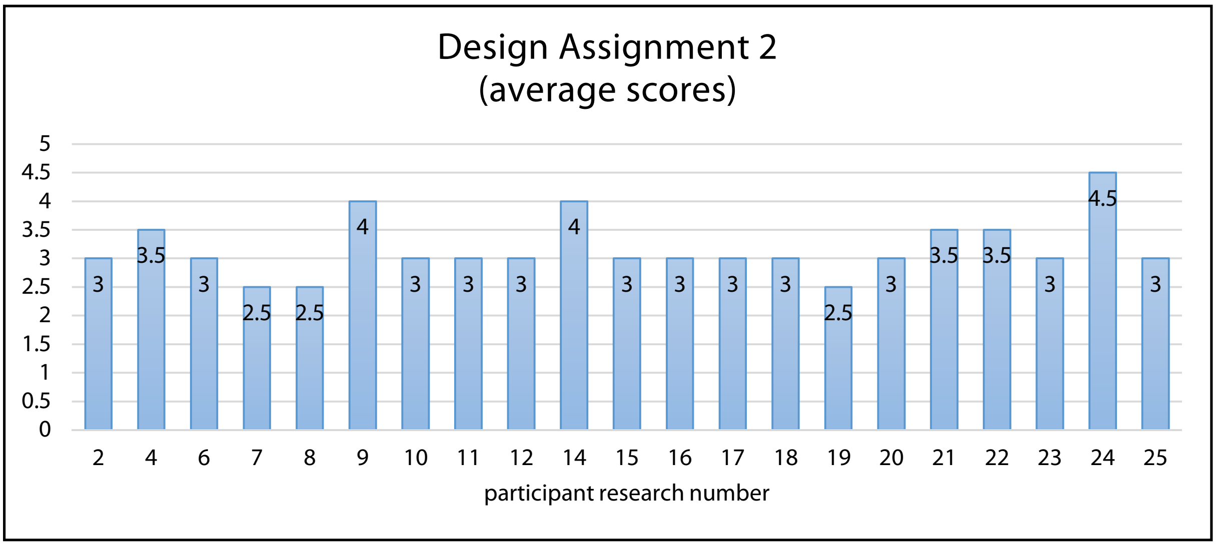


Figure 7.10: Average scores for Design Assignment 2.

7.4.3 Quantitative analysis of the Modal Agencies Intervention (Stage 1)

The Modal Intervention consisted of the following agencies:

- Ideational Modal Agency
- Sensory Modal Agency
- Logical Modal Agency
- Emotional Modal Agency.

The influence of these modal principles on the participants' semiotic transference process was collated from the qualitative data, as discussed in Chapter 4, which underwent a directed content analysis coding procedure (as described by Hsieh and Shannon, 2005) that provided content specific quotes relating to each intervention. A summative approach was used to quantify certain words in the quotes with the purpose of understanding the contextual use of the words and content. This quantification was an attempt not to infer meaning, but rather to explore usage (Hsieh & Shannon, 2005). Hence, Figure 7.11 indicates the percentage of quotes that relate to each participant's perspective on the influence each modal agency had on their semiotic transference process.

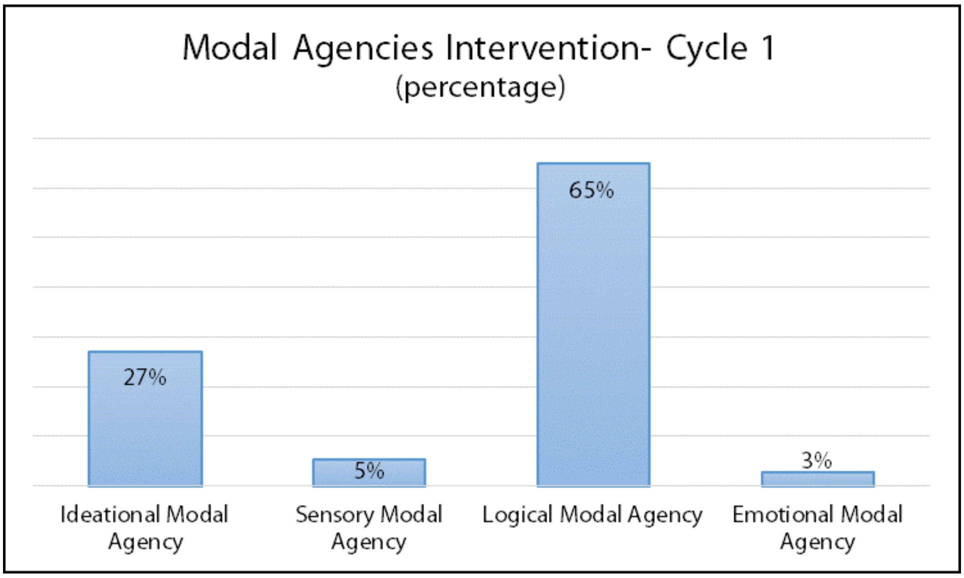


Figure 7.11: Modal Agencies Intervention Perspective Analysis (Cycle 1)

7.4.3.1.Ideational Modal Agency

The ideational modal agency consisted of the following semiotic tools:

- Theoretical content course material
- Verbal presentation
- Direct presentation, and
- Indirect representation.

Figure 7.12 indicates the percentage of quotes that relate to each participant's perspective of the influence each intervention had on their semiotic transference process.

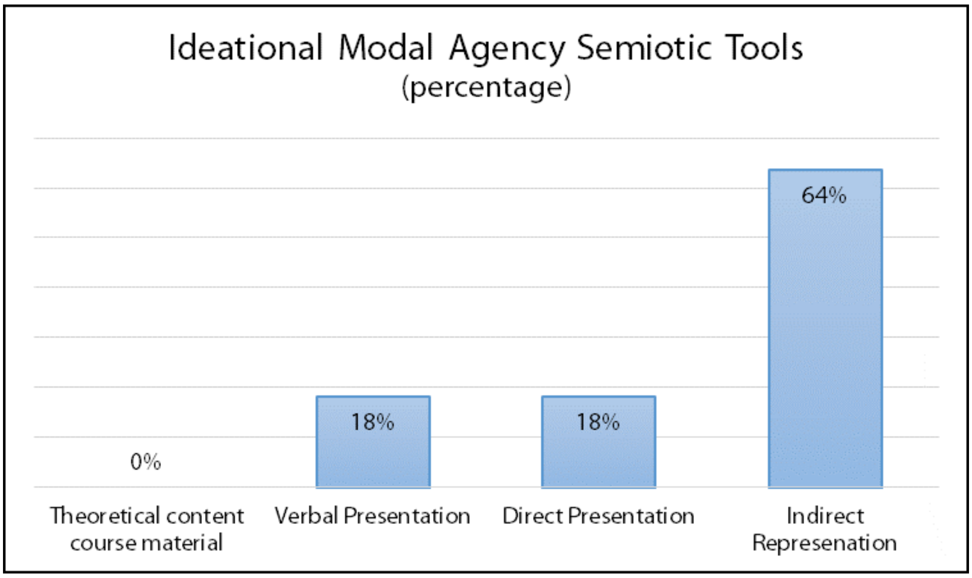


Figure 7.12: Ideational Modal Agency Semiotic Tools Perspective Analysis (Cycle 1)

a) Theoretical content course material

The participants did not directly indicate that this semiotic tool contributed to the semiotic transference process. The absence of quotes relating to this tool could be attributed to an unfamiliarity of the Participatory Action and Learning (PAL) Moodline project:

> *It's because here I was really confused what to do, how to start it* (25)

and to an inept ability to illustrate what resources was used during the design process:

> *So I was like, here I've got the influence by this line so I was a bit confused or what needs to be done* (24).

b) Verbal presentation

The influence[21] of the verbal presentation semiotic tool[22] on the semiotic transference process was classified as either contributive or non-contributive; however, there were only contributive quotes for this tool (Table 7.3).

Table 7.3: Contribution of the verbal presentation semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Facilitated the semiotic transference process between a mediate object[23] and the sign by the introduction of visual and practical activities and examples.	***	*But then this also helped me because the lecturer used this example, like exactly this symbol* [sign] *when he was explaining this thing* [theoretical concept] (9) *I think the way you explained it to us. It was like you didn't just talk. You made examples by putting the papers* (Figure 7.13), *then you asked us questions* (group interview)

[21] Derived from quotes pertaining to participants' perspectives.
[22] Verbal introduction of each theoretical concept by the lecturer.
[23] The theoretical concept of emphasis.

The verbal presentation semiotic tool only contributed 18% (Figure 7.12) to the perceived effect that the Ideational Modal Agency had on the participants; all the participants indicated that this tool contributed to their semiotic transference process. The semiotic process can further be enhanced by encouraging the participants to engage verbally with their own learning process, thus supporting semiotic transference between the theoretical concept and the theoretical content course material or notes.

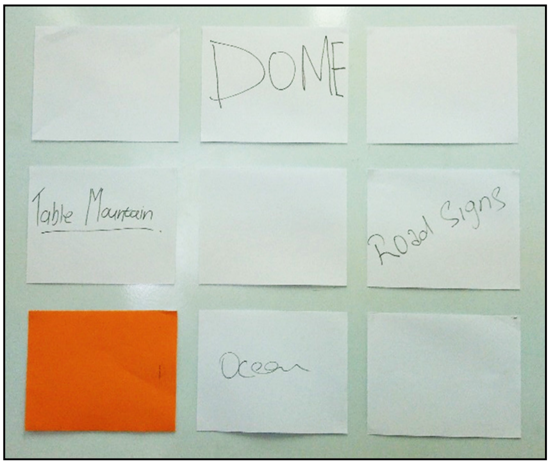


Figure 7.13: Visual examples that supported the verbal presentation semiotic tool.
Source: author

c) Direct presentation

The influence of the direct presentation semiotic tool on the semiotic transference process was classified as either contributive or non-contributive; however, there were only contributive quotes for this tool (Table 7.5).

Table 7.4: Contribution of the direct presentation semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Facilitated the direct semiotic contextualisation process, enabling the recollection of the link between the visual example[24] to a theoretical concept	***	*And here my line started to increase because I saw this picture on the board the other day (Figure 7.14)* (9)

The direct presentation semiotic tool contributed only 18% (Figure 7.12) to the perceived effect that the Ideational Modal Agency had on the participants. All of the participants indicated that this tool contributed to their semiotic transference process.

[24] Context specific icon.

The semiotic process can be further enhanced by introducing a domain specific contextual environment that will support the semiotic contextualisation process of the theoretical concept to a context specific icon[25].

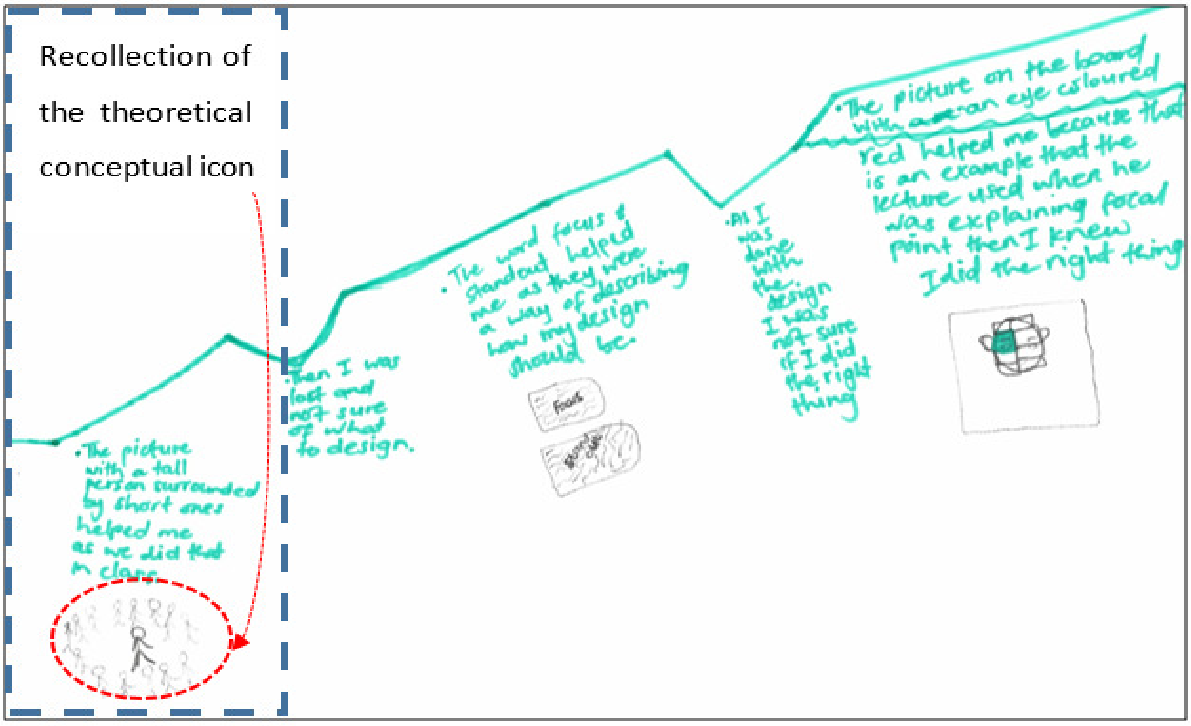


Figure 7.14: Moodline diagram indicating the recollection of the theoretical conceptual icon. Source: Author

d) Indirect representation

The influence of the indirect representation semiotic tool[26] on the semiotic de-contextualisation process was classified as either contributive or non-contributive (Table 7.5).

Table 7.5: Contribution of the indirect representation semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Created both visual and cognitive links between the theoretical concept and a direct abstract symbol.	*****	*Star* [direct abstract symbol], *the star says emphasis* [theoretical concept] (10)
Non-contributive	Underdeveloped ability to create a visual and cognitive link between the theoretical concept and an abstract symbol and then de-contextualise it into an abstract indirect representation.	***	*I didn't understood the concept of heart* [abstract symbol] (10) *I had no idea what we needed do and how are we supposed to make a heart out of the shapes* (6)

[25] Step 2 of the modal agency meaning making process.
[26] Step 4 of the modal agency meaning making process.

The indirect representation semiotic tool contributed 64% (Figure 7.12) to the perceived effect that the Ideational Modal Agency had on the participants, 65% of the participants indicated that this tool contributed to their semiotic transference process.

The indirect representation semiotic tool contributed minimally to the semiotic transference process. The semiotic de-contextualisation process can be further enhanced by creating more opportunities to facilitate the de-contextualisation processes and by incorporating the other semiotic tools as the facilitating agents in the semiotic de-contextualisation process and their outcomes, i.e. drawings, poses and designed artefacts, as the indirect representational artefacts.

7.4.3.2. Sensory Modal Agency

The Sensory Modal Agency consisted of the following semiotic tools:

- Natural iconic presentation;
- Kinesthetic drawing;
- Kinesthetic expression

Figure 7.15 indicated the percentage of quotes that relate to each participant's perspective on the influence each semiotic tool had on their semiotic transference process.

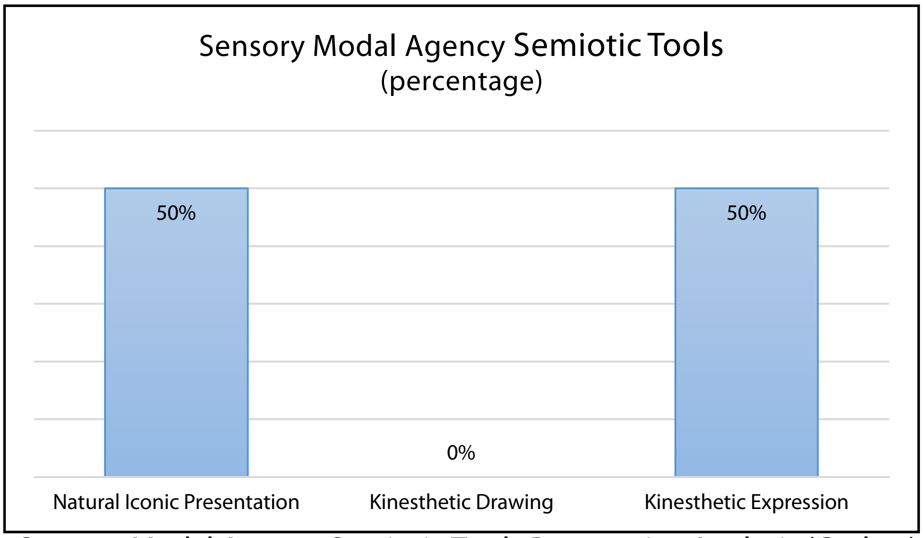


Figure 7.15: Sensory Modal Agency Semiotic Tools Perspective Analysis (Cycle 1)

a) Natural iconic presentation

The influence of the natural iconic presentation semiotic tool[27] on the semiotic transference process was classified as either contributive or non-contributive; however, there were only contributive quotes for this tool (Table 7.6).

[27] Step 2 of the modal agency meaning making process.

Table 7.6: Contribution of the natural iconic presentation semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Created an awareness that the natural environment can be a resource of natural iconic[28] examples.	*	*that's why I did put the rainy, the cloud where it's raining in the thunderstorm. And so I just like did kept this idea in my head that I should make a focus point. And so the ideas started to pop out and everything just seemed to be more clear* (21)
	Encouraged the use of the natural environment as a resource of inspiration.	*	*And then here is butterfly. It has also inspired me to do the patterns* (16)
	The natural environment was used as symbol that represented the emotional challenges some of the participants faced during the design process.	*	*My design is this* (Figure 7.14), *from this point where I drew a tree. This tree of mine has its roots exposed to the earth surface and they are not deep roots. So what happens with them, it can't produce the branches and the leaves. It has this small part that is ready to blossom but it can't because the roots are exposed to the surface. This tree, it explains that I was blank. I didn't know what to design. Like, I did not have any idea* (14).

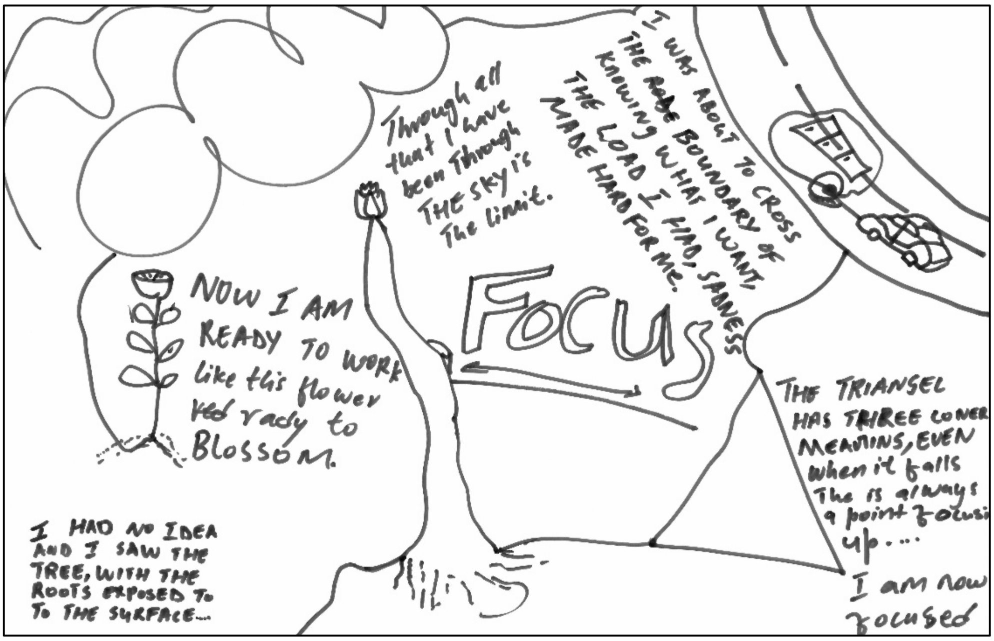


Figure 7.16: Moodline diagram indicating how nature was symbolically used.
Source: Author

The natural iconic semiotic tool contributed 50% (Figure 7.15) to the perceived effect that the Sensory Modal Agency had on the participants. The semiotic contextualisation process can be further enhanced by identifying a context specific environment to facilitate the creation of a visual and physical link between a theoretical concept and a context specific icon.

[28] Iconic refers to the resemblance or imitation of the object (theoretical concept) by looking exactly like it (i.e. photograph) in nature.

b) Kinesthetic drawing

The participants did not directly indicate that this semiotic tool contributed to the semiotic transference process. The absence of quotes relating to this tool could be attributed to the same challenges the participants faced, as discussed in section 7.4.3.1.a.

c) Kinesthetic expression

The influence of the kinesthetic expression semiotic tool[29], as applied in conjunction with both the indirect representation semiotic tool (7.4.3.1.d) and emotional group-work (7.4.3.4.a) semiotic tool, the semiotic de-contextualisation process was classified as either contributive or non-contributive; however, there was only contributive quotes for this tool (Table 7.7).

Table 7.7: Contribution of the kinesthetic expression semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	The physical activities facilitated semiotic transference from the theoretical concept into an indirect or abstract representation of a specific symbol.	*	*And I had a clear mind when we were asked to do, to show a focal point … a person who was dancing and he was the one that is dominant* (20)

The Kinesthetic expression semiotic tool contributed 50% (Figure 7.15) to the perceived effect that the Sensory Modal Agency had on the participants. The semiotic contextualisation process can be further enhanced by creating more opportunities where physical activities take place and facilitate the interpretation process, incorporating the other semiotic tools as the facilitating agents in the semiotic de-contextualisation process.

7.4.3.3. Logical Modal Agency

The Logical Modal Agency consisted of the following semiotic tools:

- Logical iconic presentation
- Logical symbolic representation, and
- Logical interpretation.

Figure 7.17 indicates the percentage of quotes that relates to each participant's perspective on the influence each semiotic tool had on his/her semiotic transference process.

[29] Step 4 and 5 of the modal agency meaning making process.

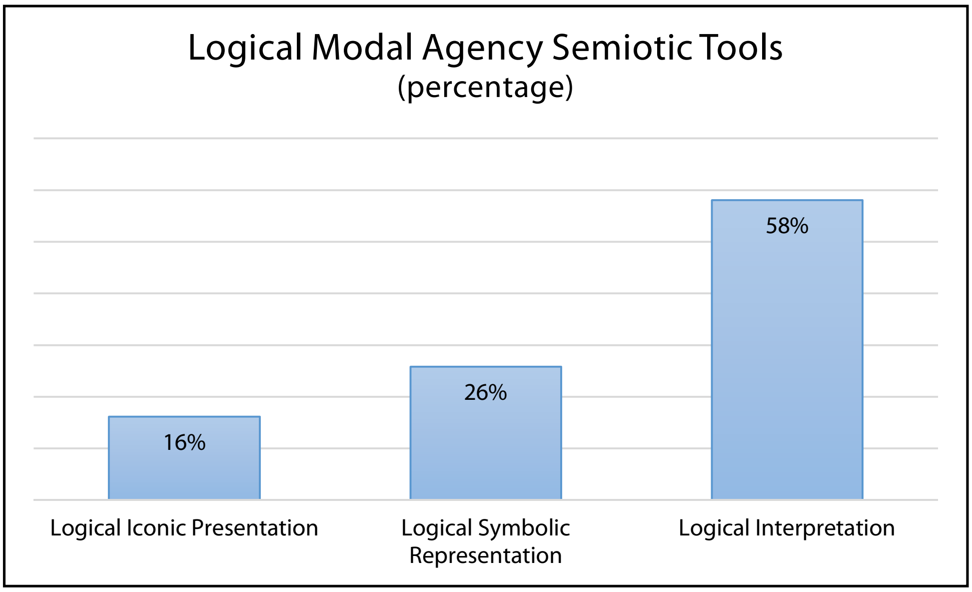


Figure 7.17: Logical Modal Agency Semiotic Tools Perspective Analysis (Cycle 1)

a) Logical iconic presentation

The influence of the logical iconic presentation semiotic tool[30] on the semiotic contextualisation process, as applied in conjunction with both the direct presentation semiotic tool (7.4.3.1.c) and the natural iconic presentation semiotic tool (7.4.3.3.a), was classified as either contributive or non-contributive (Table 7.8).

Table 7.8: Contribution of the logical iconic presentation semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Stimulated a spatial sensitivity to visual signs.	*	*And then here is butterfly. It has also inspired me to do the patterns* (Figure 7.18). *Then here I have mixed emotions, ja* [yes]. *But I was very happy with my work* (16)
Non-contributive	Weak semiotic link between the theoretical concept and the context specific icon, thus difficulty remembering the theoretical concept.	****	*I didn't really remember any of them well, not as easily* (15), *like I was lost. I saw these shapes*[31] *. I wasn't sure like what to do* (9).

[30] Step 2 and 3 of the modal agency meaning making process.
[31] The three basic geometric shapes of the design assignment.

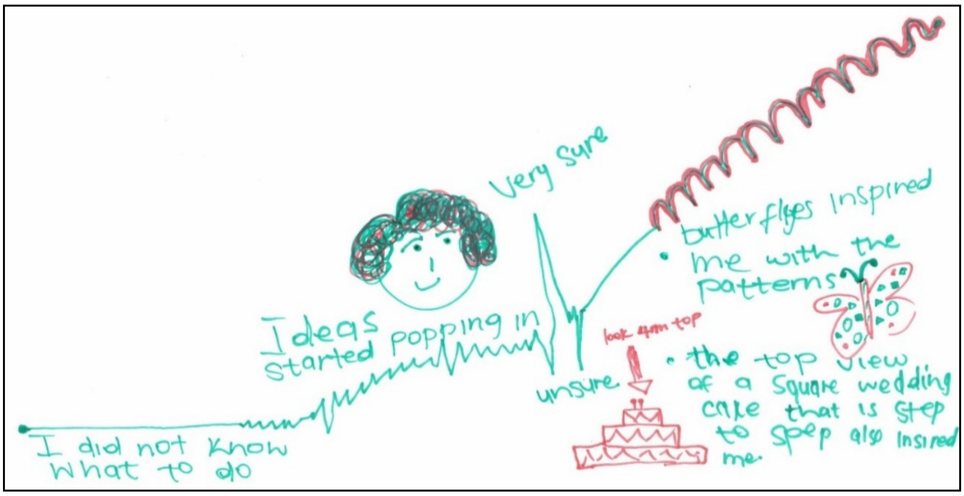


Figure 7.18: Moodline diagram indicating the link between the theoretical concept and a context specific icon.

Although this semiotic tool contributed 16% (Figure 7.17) to the perceived effect that the Logical Modal Agency had on the participants, only one of the five quotes indicated that this tool contributed to their semiotic transference process.

The semiotic contextualisation process can be further enhanced by: developing and strengthening the context specific platform and facilitate opportunities to create more basic visual connection activities between the theoretical concept and a context specific icon.

b) Logical symbolic representation

The influence of the logical symbolic presentation semiotic tool[32] on the semiotic re-contextualisation process, as applied in conjunction with both the indirect representation (7.4.3.1.d) and logical interpretation (7.4.3.3.c) semiotic tools, was classified as either contributive or non-contributive; however, there was only contributive quotes for this tool (Table 7.9).

Table 7.9: Contribution of the logical symbolic representation semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Visual and verbal analogies supported the re-contextualisation transference between the Abstract Symbol and the Abstract Interpretation, enabling the recollection process of the Abstract Symbol.	**** ****	*I saw a picture of a person in the board* [visual analogy], *which was lying down and there was a ball on top of her* (Figure 7.19). *I immediately recognise the board, design something with the ball and then I saw the word heart* [abstract symbol]… *thinking about what kinds of shapes I can make* [abstract interpretation] *it easier for me to choose these ideas* (10)

[32] Steps 4 and 5 of the modal agency meaning making process.

This semiotic tool contributed 26% (Figure 7.17) to the perceived effect that the Logical Modal Agency had on the participants. All the participants' quotes indicated that this tool had contributed to their semiotic transference process.

The semiotic contextualisation process can be further enhanced by encouraging the development of various abstract symbols for each theoretical concept.

Figure 7.19: Visual analogy illustrating emphasis.
Source: www.tandonz.blogspot.co.za)

c) Logical interpretation

The influence of the logical interpretation semiotic tool[33] (only implemented during stage 2) on the re-semiotisation and re-contextualisation process was classified as either contributive or non-contributive (Table 7.10).

Table 7.10: Contribution of the logical interpretation semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Encouraged the participants to re-contextualise the context specific theoretic symbolic representamen[34] into an abstract artefact, using only the primary geometric shapes.	*********	*Because there were squares and I used them on my composition and I used some circles to try to do my composition like with – my focus point was on the circle* (17)
	The geometric shapes simplified this process, encouraging experimentation for different design solutions.	*****	*My brain felt like had an electric generator, you see. So – and I just cut the shapes and paste just playing the emphasis* (22) *Thinking about what kinds of shapes I can make it easier for me to choose these ideas* (10)
Non-contributive	Perspectives that the use of geometric shapes to re-contextualise an Abstract Symbol to an Abstract Interpretation was seen as undignified and limiting to their creative abilities.	**	*I turned the page I saw shapes and I was a bit demotivated because I thought that it was Grade R work* (25)
	The geometric shapes restricted the creative process.	****	*think the fact that you are given the shapes and we cannot use nothing more than the shapes* (group interview)

33 Step 5 of the modal agency meaning making process.
34 All three types of signs: the icon, the index and the symbol.

This semiotic tool had the highest contribution (58%) (Figure 7.17) to the perceived effect that the Logical Modal Agency had on the participants. Fourteen (14) of the 20 quotes (70%) indicated that this tool contributed to their semiotic transference process.

The semiotic re-contextualisation process can be further enhanced by explaining the use of geometric shapes in the design assignment and implementing various design assignments to de-contextualise and re-semiotise various representamen into abstract artefacts.

7.4.3.4. Emotional Modal Agency

The Emotional Modal Agency consisted of the following semiotic tools:

- Group-Work
- Friends/peers discussion
- Individual reflection
- Self-Study

Figure 7.20 indicates the percentage of quotes that relates to each participant's perspective on the influence each semiotic tool had on his/her semiotic transference process.

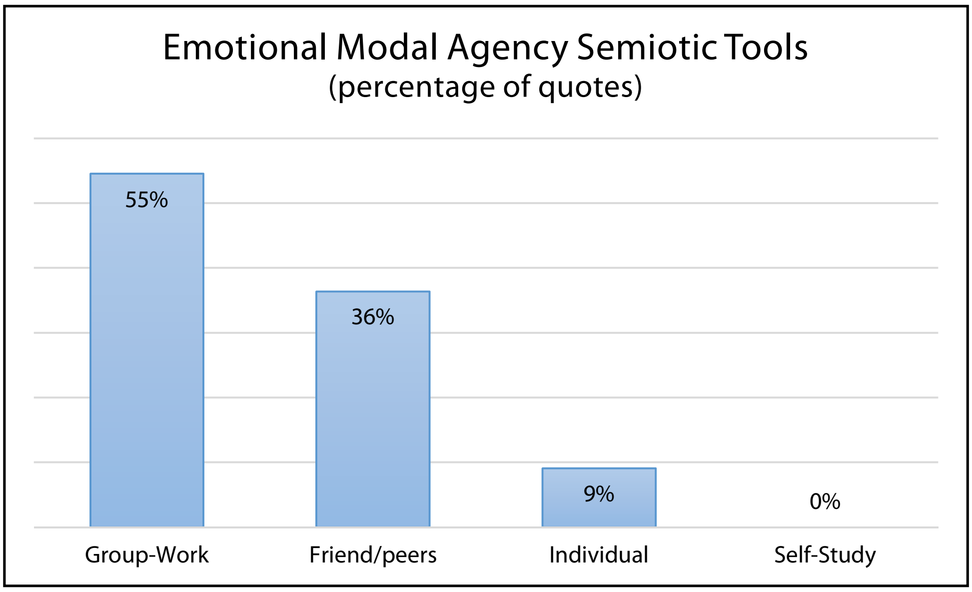


Figure 7.20: Emotional Modal Agency Semiotic Tools Perspective Analysis (Cycle 1)

a) Group-Work

The influence of the group-work semiotic tool[35] on the semiotic transference process was classified as either contributive or non-contributive; however, there were only contributive quotes for this tool (Table 7.11).

[35] Steps 1 - 4 of the modal agency meaning making process.

Table 7.11: Contribution of the group-work semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Created an environment that encouraged the use of different knowledge resources.	**	*This is where we exchange ideas for experience…building from one another…Yes, so it grows in strength and confidence* (group interview)
	Facilitated creative interaction between group members.	*	*That's where most of us can voice our ideas because if like we do like individual things, most of the people are – they get like tired of doing – but if we're in groups there are more ideas popping in* (group interview)
	Encouraged collaborative learning through social interaction between group members.	***	*We have to socialise be able to interact in class, be able to learn from one another… it is the laughing that helped the most* (group interview)

This semiotic tool had the highest contribution of 55% (Figure 7.20) to the perceived effect that the Emotional Modal Agency had on the participants. All of them indicated that this tool had contributed to their semiotic transference process.

The semiotic contextualisation process can be further enhanced by enabling the groups to facilitate different activities in different theoretical concepts, and by incorporating group-work in all the steps of the modal agency meaning making process (Figure 6.4).

b) Friends/peers discussion

The influence of the friends/peers semiotic tool[36] on the semiotic transference process was classified as either contributive or non-contributive; however, there were only contributive quotes for this tool (Table 7.12).

Table 7.12: Contribution of the friends/peers discussion semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Created an awareness that the verbal resources of 'others' can support semiotic transference of theoretical concepts.	**	*So those like if you don't understand you can actually ask the person next to you that hey…What does this thing mean?* (group interview)
	Encouraged collaborative learning through the creation of a supportive social environment.	**	*But when you ask to one of your classmates, you will never be scared* (group interview)

This semiotic tool had the second highest contribution of 36% (Figure 7.20) to the perceived effect that the Emotional Modal Agency had on the participants. All of them indicated that this tool had contributed to their semiotic transference process.

The semiotic contextualisation process can be further enhanced by encouraging the use of friends/peers as an important information resource, and by creating a collaborative learning and

[36] Steps 1 - 4 of the modal agency meaning making process.

reflective environment that encourages friends/peers to assist in explaining the theoretical concepts, but also in reassessing how that knowledge was perceived.

c) Individual reflection

The influence of the individual reflection semiotic tool[37] on the semiotic transference process was classified as either contributive or non-contributive; however, there were only non-contributive quotes for this tool (Table 7.13).

Table 7.13: Contribution of the individual reflection semiotic tool (Cycle 1)

Contribution	Influence	FRQ	Illustrative quotes
Non-contributive	Working individually was perceived to limit creativity and non-contributive to the semiotic transference process.	*	*if like we do like individual things, most of the people are – they get like tired of doing– but if we're in groups there are more ideas popping in* (group interview)

This semiotic tool had the lowest perceived effect (9%) (Figure 7.20) on the contribution that the Emotional Modal Agency had on the participants. Only one participant mentioned it.

The semiotic contextualisation process can be further enhanced by encouraging the implementation of this tool in all the steps of modal agency meaning making process (Figure 6.4) and by creating a platform to incorporate this tool as an enabling agent in the semiotic contextualisation process.

d) Self-study

The participants did not directly indicate that this semiotic tool contributed to the semiotic transference process. The absence of quotes relating to this tool could be attributed to the same challenges the participants faced, as discussed in section 7.4.3.1.a.

7.4.4 Overall reflection after iterative cycle 1

The qualitative data on the perceived contribution of all the Modal Agencies on each of the participants' semiotic transference process were quantified and indicated in Figure 7.21. The bar graph clearly indicates the contributive value variance of each modal agency intervention on every participant. Overlaying that graph with the scores from design assignment 2, indicates a comparison between the perceived contribution that the Modal Agency intervention had and how it contributed to re-semiotisation and re-contextualisation of a theoretic concept into an abstract artefact.

[37] Steps 1 - 4 of the modal agency meaning making process.

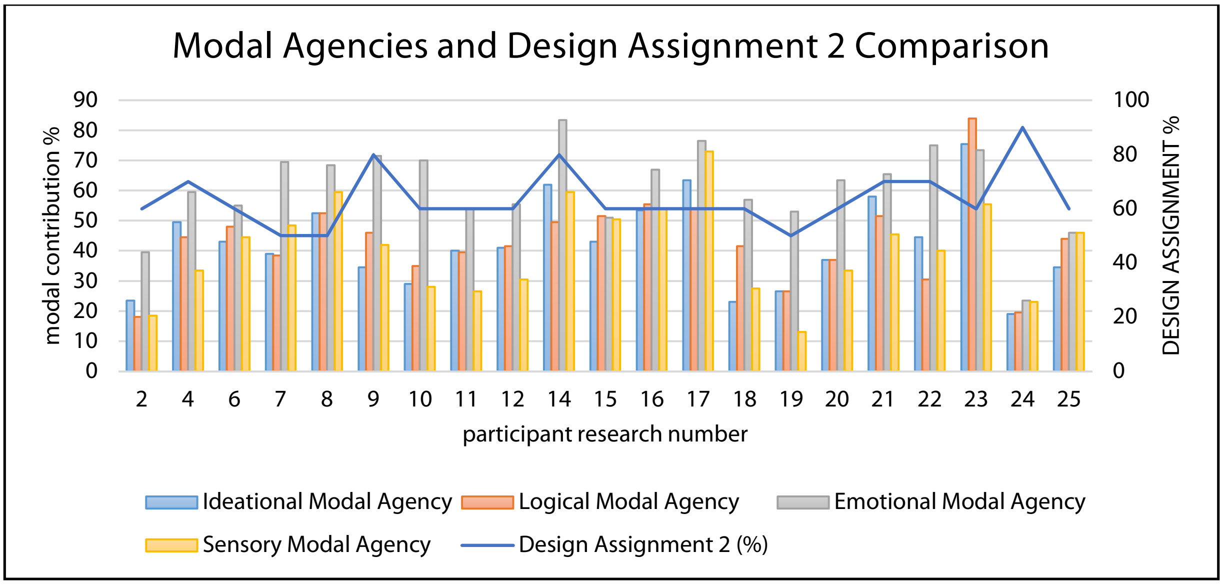


Figure 7.21: Comparison of the modal agencies and Design Assignment 2 (Cycle 1)

The modal agency intervention created a platform that not only contributed to each individual participant's semiotic processes, but also facilitated an authentic, domain specific, teaching and learning environment that encouraged collaborative learning.

Although the participants enjoyed the traditional indoor studio teaching and learning environment, some still struggled connecting the theoretical concepts to the specific environmental context.

The Participatory Action and Learning (PAL) project's tool, the individual participant Moodline diagram (as discussed in section 7.4.3.1.a), focused the participants' attention to analysing their design process in terms of a linear process, limiting the reflection of what resources were used and how effective those resources were in terms of their design process.

The following issues must be addressed in Iterative Cycle 2 to further enhance the semiotic contextualisation process:

- Introduce context specific theoretical content course material;
- Encourage the participants to verbally engage with their own learning process;
- Introduce a domain specific contextual environment that will support the semiotic contextualisation process;
- Create more opportunities to facilitate the contextualisation processes by incorporating the other interventions as the facilitating agents;
- Use the context specific environment to facilitate the creation of a visual and physical link between a theoretical concept and a context specific icon;
- Create opportunities where physical activities and facilitate interpretation process;
- Encourage the development of various abstract symbols for each theoretical concept;

- Explain the use of geometric shapes in the design assignment;
- Implement various design assignments to de-contextualise and re-semiotise various representamen into abstract artefact;
- Enable the groups to facilitate different activities in different theoretical concepts;
- Encourage the use of friends/peers as an important information resource, and
- Encourage all the participants to individually engage in their learning process.

7.5 Iterative cycle 2

The second iterative cycle was implemented in April 2017 (Figure 7.22). Table 7.14 shows how meaning was transferred from the theoretical concept, for this iterative cycle 'symmetry and balance' (section 7.5.1), through the modal agency meaning making process intervention (Figure 7.2).

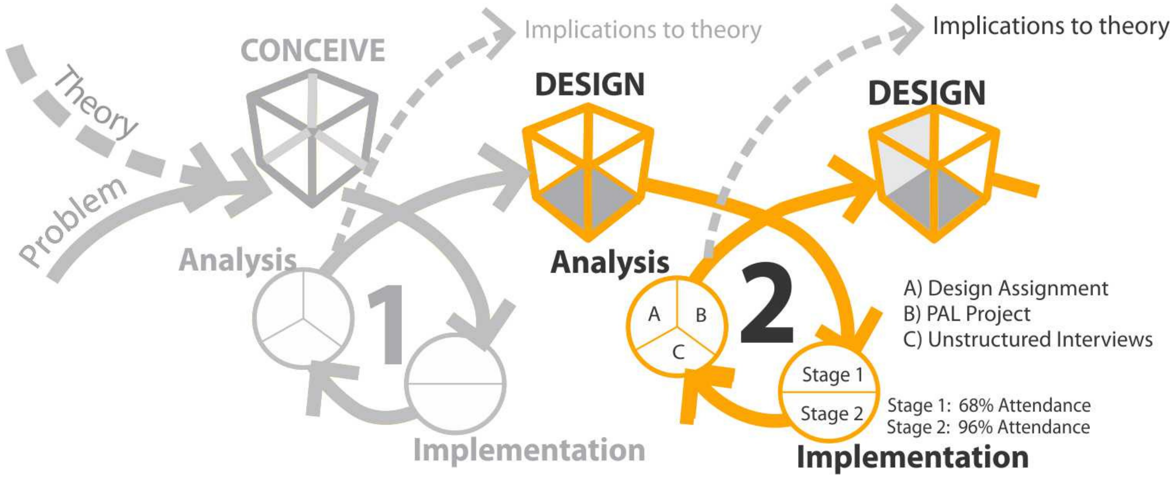


Figure 7.22: Iterative Cycle 2

7.5.1 Basic Design Principle: Symmetry and balance

Symmetry adds balance to a design, and balance is the equal distribution of visual weight that creates harmony, unity and order (Tersiisky, 2004; Knight, 2011). The lesson focused on the following principles of symmetry and balance, dividing them into the following concepts:

- Concept 1: Reflection symmetry

  Reflection symmetry is also known as bilateral symmetry. It is the "mirror" effect, or when one object is reflected across a plane to create another instance of itself.

- Concept 2: Rotational symmetry

  Rotational symmetry (or radial symmetry) is when an object is rotated in a certain direction around a point.

- Concept 3: Translational symmetry

  Translational symmetry is when an object is relocated to another position while maintaining its general or exact orientation.

- Concept 4: Asymmetry

  Asymmetry is the lack of symmetry. Asymmetry can also represent an object that breaks a predefined pattern of symmetry, or an imbalance of design elements.

- Concept 5: Balance

  Balance is in a state of equilibrium or equipoise, an interpretation of a design's gravity and its distribution of elements. Balance is not limited to size only. It also delves into other elements such as colour, space, texture and value. It can be descriptive, implied, or abstract.

Table 7.14: Iterative cycle 2 modal agency intervention – Stage 1

Theoretical Concept	DKSP Steps	Modal Agency and Semiotic Tools	Activity
Introduction - balance and symmetry - in class	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally introduced the theoretical concept in class.
	1	Ideational Modal Agency: - the theoretical content course material	Each participant received the theoretical content course material.
	1	Sensory Modal Agency: - Kinesthetic Expression	The whole class participated in a physical activity about opposites.
Concept 1: Reflection Symmetry (Outdoors)	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally explained the concept of reflection symmetry.
	2	Ideational Modal Agency: - Direct Presentation - Verbal Presentation Sensory Modal Agency: - Natural Iconic Presentation Emotional Modal Agency: - Individual	Each participant had to identify and collect an example that represents reflection symmetry. These were physical examples in nature (leaves and flowers). Each participant verbally and visually presented it to the class and discussed it.
	3	Sensory Modal Agency: - Kinesthetic Expression Emotional Modal Agency: - Group-work	Groups of two. Participant A received, in secret, a natural reflection symmetry example. Participant B received a piece of chalk to draw. Part 1, drawing only halve of the example in large scale, 1 x 1 meters. Participant A had to explain verbally how participant B must draw that example without seeing it. Part 2, Participant A must now draw the second halve in reflection (Figure 7.23).
Concept 2: Rotational Symmetry (Outdoors)	1 and 2	Ideational Modal Agency: - Verbal Presentation - Direct Presentation Sensory Modal Agency: - Natural Iconic	The lecturer verbally explained the concept of rotational symmetry. The lecturer walked around with all the participants in a parking area and asked the participants to identify examples of rotational symmetry around them, i.e. car emblems and street signs.
	2	Ideational Modal Agency: - Verbal Presentation - Direct Presentation Sensory Modal Agency: - Natural Iconic Emotional Modal Agency: - Group-work Logical Modal Agency: - Logical Iconic Presentation	All the participants were divided into four groups. The participants in each group had to identify and collect a rotational symmetry example in nature and bring it to their group and discuss.
	3 and 4	Ideational Modal Agency: - Indirect Representation Sensory Modal Agency: - Kinesthetic Expression - Kinesthetic Drawing	Each group had to create a human scale drawing that represents rotational symmetry. Part 1, the participants had to create a template, using a participant's body and trace it with chalk on the ground. They had to try

		Emotional Modal Agency: - Group-work Logical Modal Agency: - Logical Symbolic Representation	different poses and elements of the body to create the template. Part 2, the groups created a human scale drawing that represented rotational symmetry on the ground with chalk, using the template (Figure 7.24).
<u>Concept 3:</u> Translational Symmetry (Outdoors)	1 and 2	Ideational Modal Agency: - Verbal Presentation - Direct Presentation Sensory Modal Agency: - Natural Iconic	The lecturer verbally explained the concept of translational symmetry. The lecturer walked around with all the participants in a parking area and asked the participants to identify examples of translational symmetry in car emblems.
	3	Ideational Modal Agency: - Indirect Representation Sensory Modal Agency: - Kinesthetic Expression Emotional Modal Agency: - Group-work Logical Modal Agency: - Logical Symbolic Representation	Each group had to create a pose using all the participants, but the shadow of that pose had to illustrate translational symmetry (Figure 7.25).
<u>Concept 4:</u> Asymmetry (Outdoors)	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally explained the concept of asymmetry.
	2	Ideational Modal Agency: - Direct Presentation - Verbal Presentation Sensory Modal Agency: - Natural Iconic Presentation Emotional Modal Agency: - Individual	Each participant had to identify and collect an example that represents asymmetry. These were physical examples in nature (leaves and flowers). Each participant verbally and visually presented it to the class and discussed it.
	3	Sensory Modal Agency: - Kinesthetic Expression Emotional Modal Agency: - Group-work	Create a group pose that illustrates asymmetry
	4	Ideational Modal Agency: - Indirect Representation Sensory Modal Agency: - Natural Iconic Presentation Emotional Modal Agency: - Individual	Each participant had to individually identify a tree that is asymmetrical and draw it.
<u>Concept 5:</u> Balance	1	Emotional Modal Agency: - Self-Study	Participants were instructed to study and research this concept on their own time.

Figure 7.23: Group activity illustrating reflection symmetry.
Source: Author

Figure 7.24: Group activity illustrating rotational symmetry
Source: Author

Figure 7.25: Group activity illustrating translational symmetry.
Source: Author

7.5.2 Qualitative analysis of Design Assignment 3 (Stage 2)

The outcomes of the design assignment 3 were evaluated on an achievement scale of between1 and 5 (see design assessment rubric in Addendum F). The design assignments were objectively evaluated by two independent assessors, and the agreement between assessors was analysed for each task. The Cronbach Alpha tests of inter-observer reliability for different combinations of two assessors indicated an excellent reliability of 0.93 between the two judges on each task.

A detailed table of the results obtained by the participants in design assignment 3, is presented in Addendum H. The scores were standardised (Table 7.15), in the aggregate; the average percentage scores for the participants ranged between 2.5 (the design idea/solution did satisfy the design requirements) to 5 (the design idea/solution did satisfy the design requirements), with a mean score of 3.78 (one or both compositions indicated emphasis, but there was either no difference in the methods used, wrong, or no indication of the method used); (the design idea/solution did satisfy the design requirements). The bar chart for the average percentage scores of each participant is shown in Figure 7.26. The mean score of 3 (score level of 60%) indicated that halve of the participants scored 60% and above, with the highest number of participants (7) in the score frequency interval between 4.0 and 4.4. (Figure 7.27). The minimum score of 2.5 (score level of 50%), 2 participants, highlighted that all the participants were able to indicate symmetry, but still struggled to completely satisfy the whole assignment.

Table 7.15: Descriptive statistics of Design Assignment 3

Design Assignment 3 aggregate scores	
Mean	3.79
Standard Deviation	0.72
Minimum	2.5
Maximum	5

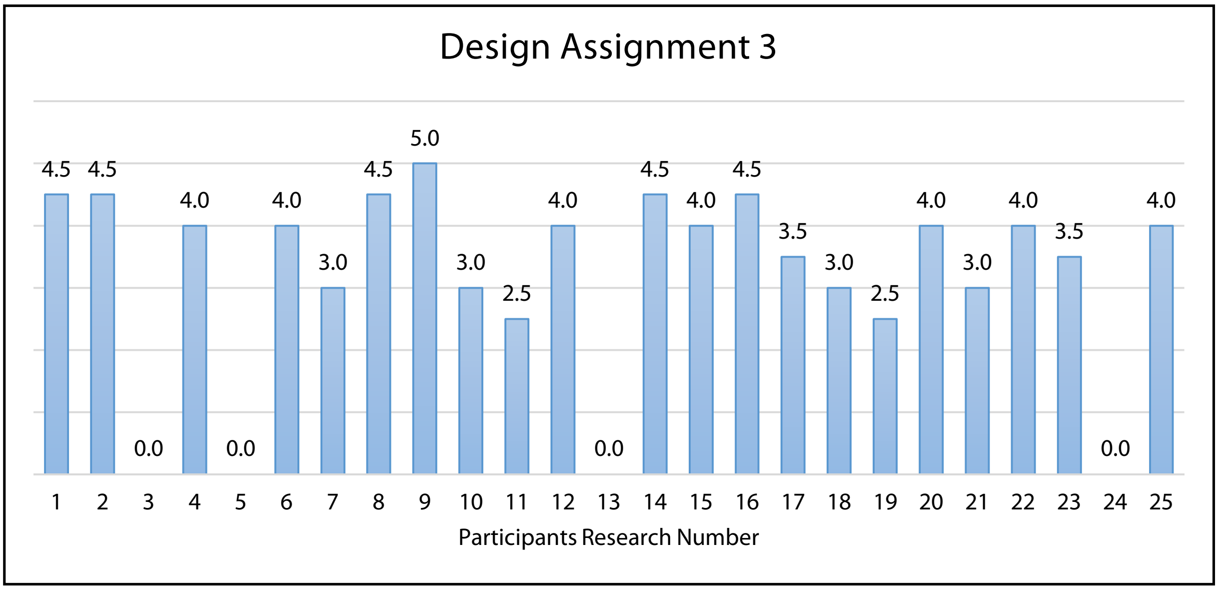


Figure 7.26: Achievement levels of Design Assignment 3 (Cycle 2)

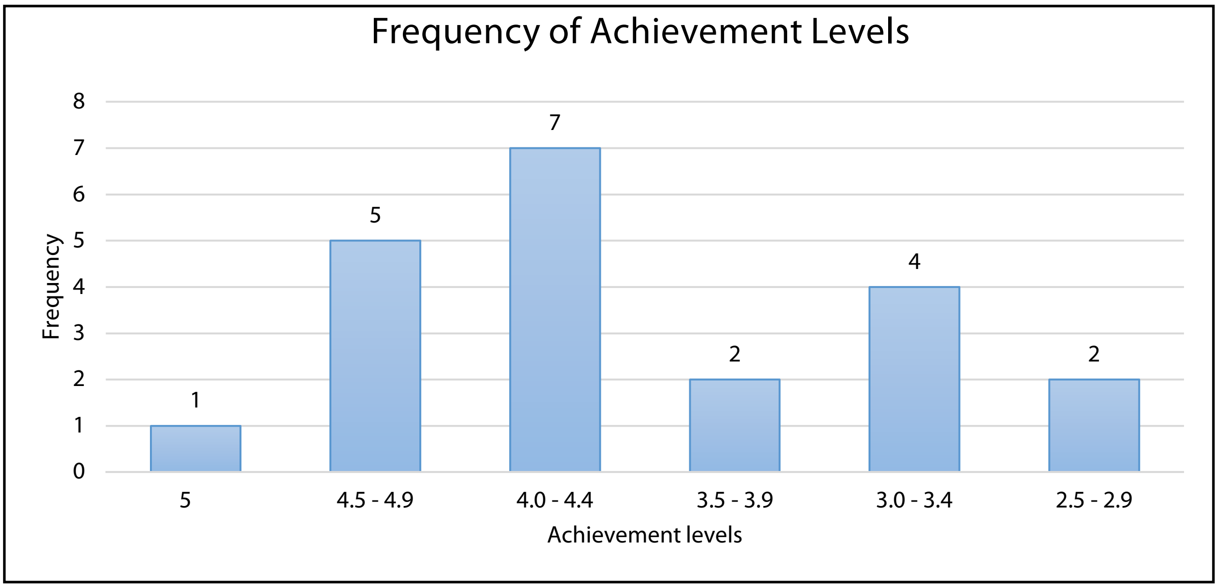


Figure 7.27: Frequency of achievement levels in Design Assignment 3 (Cycle 2)

7.5.3 Quantitative analysis of the Modal Agencies Intervention (Stage 1)

The Modal Intervention consisted of the following agencies (Figure 6.4):

- Ideational Modal Agency
- Sensory Modal Agency
- Logical Modal Agency
- Emotional Modal Agency.

Figure 7.28 indicates the percentage of quotes that relates to each participant's perspective on the influence that each agency had on their semiotic transference process.

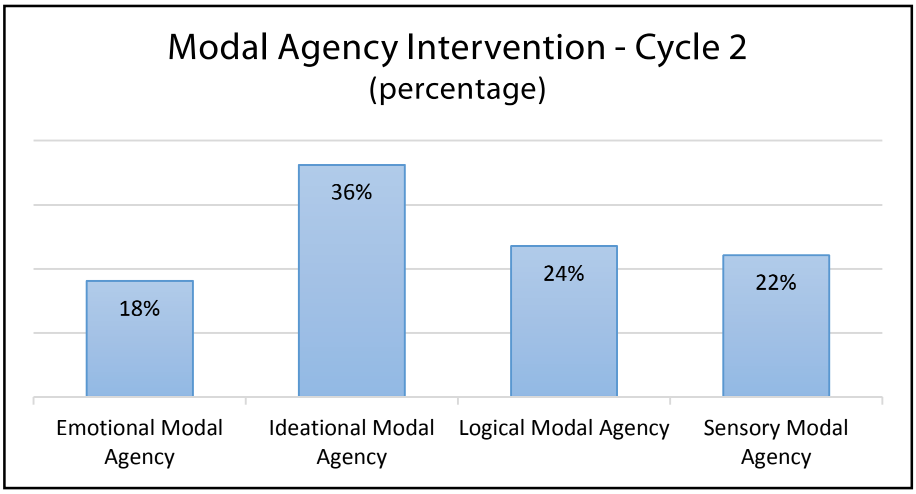


Figure 7.28: Modal Agency Intervention Perspective Analysis (Cycle 2)

7.5.3.1. Ideational Modal Agency

The Ideational Modal Agency consists of the following semiotic tools:

- Theoretical content course material

- Verbal presentation
- Direct presentation
- Indirect representation.

Figure 7.29 indicates the percentage of quotes that relates to each participant's perspective on the influence that each intervention had on his/her semiotic transference process.

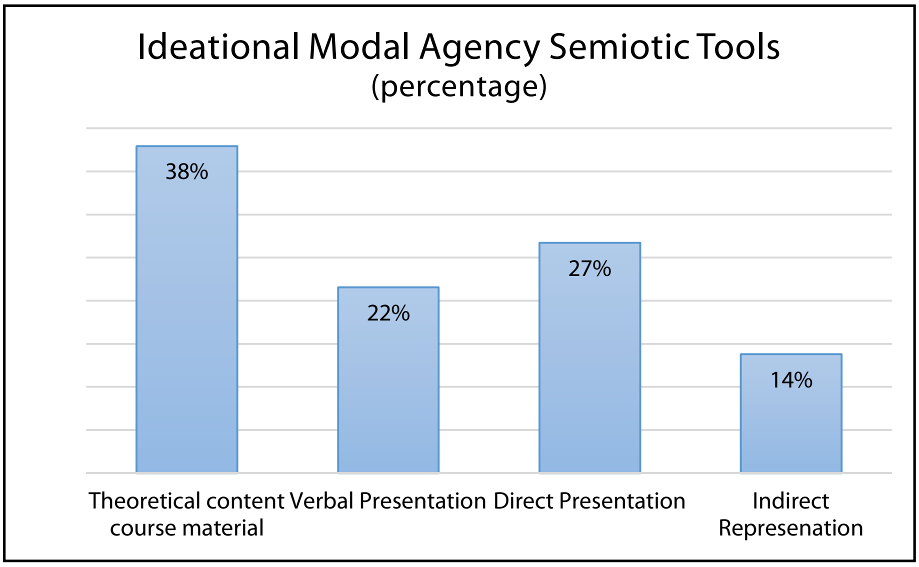


Figure 7.29: Ideational Modal Agency Semiotic Tools Perspective Analysis (Cycle 2)

a) Theoretical content course material

The influence of the theoretical content course material (notes) semiotic tool on the semiotic contextualisation process was classified as either contributive or non-contributive (Table 7.16).

Table 7.16: Contribution of the theoretical content course material semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive	Created a visual and verbal link between the theoretical concept and the sign (icon or symbol).	******	*In a theoretical way. I was able to read what I saw* (18) *Then the drawings that I saw on the notepaper, there were three different drawings* [sign]. *There was rotation, reflection and I can't remember the last one* [theoretical concepts]. *And then I read the notes and they also helped me get a clear picture of what the symmetry is* (17)
	Provided a theoretical resource that facilitates the interpretation process beyond the classroom context.	*******	*So after the drawings I read notes and they sort of helped me because reading those notes explained further what was explained by the drawings…and also we had more information by reading the notes and you explaining the lesson or the topic that we were doing yesterday* (group interview)
	The physical and cognitive interaction between the notes (mediate object) and the sign enhanced the understanding and reflective process.	****	*The other thing that I think it's helping me is taking notes every time that we're in class and we're taught something that will give me an opportunity to understand and*

			for me to find some information when I've got some lack of knowledge (19)
	Encouraged the participants to individually extend their learning process beyond the classroom context.	***	*The other thing is, you know, when we are given something to go and investigate about, that information that we got for investigation, it never leaves our minds unlike the one that we're taught* (group interview) *So with the notes I read yesterday and today before coming to this class, so it's the one, very important* (11).
	Extending the learning process beyond the classroom context open up more time for the participant to interpret the theoretical concepts.	**	*The notes helped me almost like the drawings because I can go through the notes by myself, step by step following easily. So I can understand it better than just going fastly through it* (23) *And notes, you can sit at home and read through it just to pass time, especially when you have nothing to do* (group interview)
	The notes sustained the semiotic transference by becoming a reflective and prompting resource, assisting the participants to remember the theoretical concept.	***	*They helped me a lot because I was able to remember* (16) *So with the notes I read yesterday and today before coming to this class, so it's the one, very important* (11)
Non-contributive	An English language and reading skills barrier, that some of the participants at CPUT faced, caused reading and understanding the notes to be problematic.	**** **** **	*Because it didn't really help me. I didn't understand what it was* (15) *I was reading the notes since I didn't attend the class yesterday. So I was reading like yoh. The notes, ja they didn't help me that much* (group interview)
	Resistance to reading due to a perception that notes are only there for assessment and not for understanding.	*	*And then we're not reading for understanding. We are reading for the test* (group interview)
	Reading alone did not create a strong semiotic link between the theoretical concept and the sign – which led to participants struggling to remember that link.	**	*To remember the notes we had to read and then we have to read again, to remember what you read on the notes* (15)
	The visual link between the written text and the images in the notes was not emphasised enough.	**	*It's because the notes without the picture are not like really clear* (14) *The notes, I didn't understand what it was talking about. The lecturer tried to explain it to us but I couldn't get like what it was talking about and the image it didn't really help me* (15)
	A perception among some participants that, if they understood the theoretical concept, further reading and studying that was unnecessary.	**	*I didn't bother to read my notes because lecturer has already explained for us* (22)

This modal semiotic tool must be implemented in conjunction with the other modal tools to facilitate the interpretation process:

> *But once we did the physical activity and the drawing and the group-work, then I got to see what the lecturer was talking about in class and what the notes meant* (1)

And then the other thing was the notes that we were given, the hand-out actually. It explained into detail about the activities. That helped as well (12).

The analysis also indicated, as reflected in Figure 7.30, that notes had a higher contribution to the semiotic transference process for absent participants:

The bigger circle is notes because I got notes from one of my classmates here and then I read through it so it gave me a lot of information (11)

What helped me are the notes, which I was given by a friend (16).

The above quotations highlight the interdependence of the other modal tools to facilitate this process.

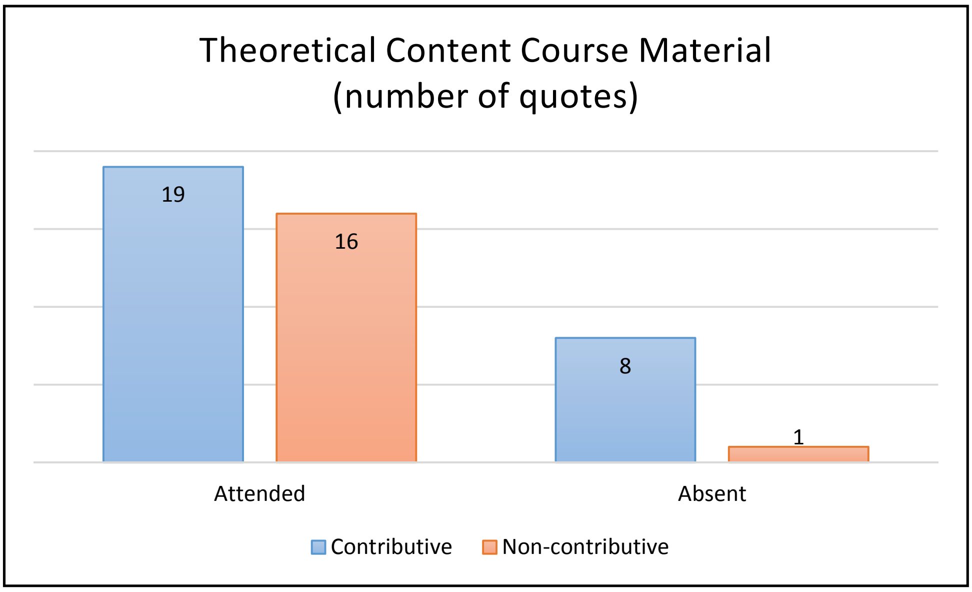


Figure 7.30: Contribution of the theoretical content course material semiotic tool (Cycle 2)

The theoretical content course material modal semiotic tool contributed to the semiotic transference process by the creation of a visual and verbal link between the mediate object and the sign. The success of this tool relies on its integration with the other three main modal agencies. The semiotic process can be further enhanced by: introducing more context specific and interactive visual resources, encouraging extended individual learning and research activities and addressing the reading challenges that the participants face.

b) Verbal presentation

The influence of the verbal presentation intervention on the semiotic transference process was classified as either contributive or non-contributive (Table 7.17).

Table 7.17: Contribution of the verbal presentation semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycle 1.	Facilitated the semiotic transference process between the theoretical concept and the sign by the introduction of visual and practical activities and examples.	*****	*this a thing I like the most because teacher, lecturer teach us how to draw the symmetry* [theoretical concept](22) *It's better when you explain it yourself* [lecturer] *and we do the practical* (group interview)
Contributive: Iterative cycle 2.	Verbally facilitated the semiotic transference process between the theoretical concept and the sign.	***	*the lecturer also helped me by explaining the symmetry and asymmetry* [theoretical concept] (18)
	Supported the creation of a cognitive link between the theoretical concept and the notes.	**	*And another thing that helped me was the lecturer himself because he is the one who explained more on the, on what was said by the notes. So he helped me very much* (25)
	Encouraged active participation in their own learning process.	*	*So I think it's also somehow good to some of us to investigate and then get the lecturer to confirm. Like the lecturer will just confirm that, okay what you got is right or what you got is wrong. It's only then you can learn* (group interview)
Non-contributive[38]: Iterative cycle 2.	The semiotic transference through verbal presentation required that the participant had to be physically present.	**	*the lecture was the least thing that helped me because yesterday I was not in class and the lecturer did not explain it again to me* (17)
	The language barriers were intensified by the verbal intervention.	***********	*such that I didn't hear anything from the lecturer… I heard like a little bit of that, of this and that* (4) *I didn't understand what it was talking about. The lecturer tried to explain it to us but I couldn't get like what it was talking about* (15)

Although the verbal presentation semiotic tool contributed 22% (Figure 7.28) to the perceived effect that the Ideational Modal Agency had on the participants; more than half of all the participants indicated that this tool did not contribute to their semiotic transference process (Figure 7.31).

[38] There were no non-contributive recurring contributions from iterative cycle 1.

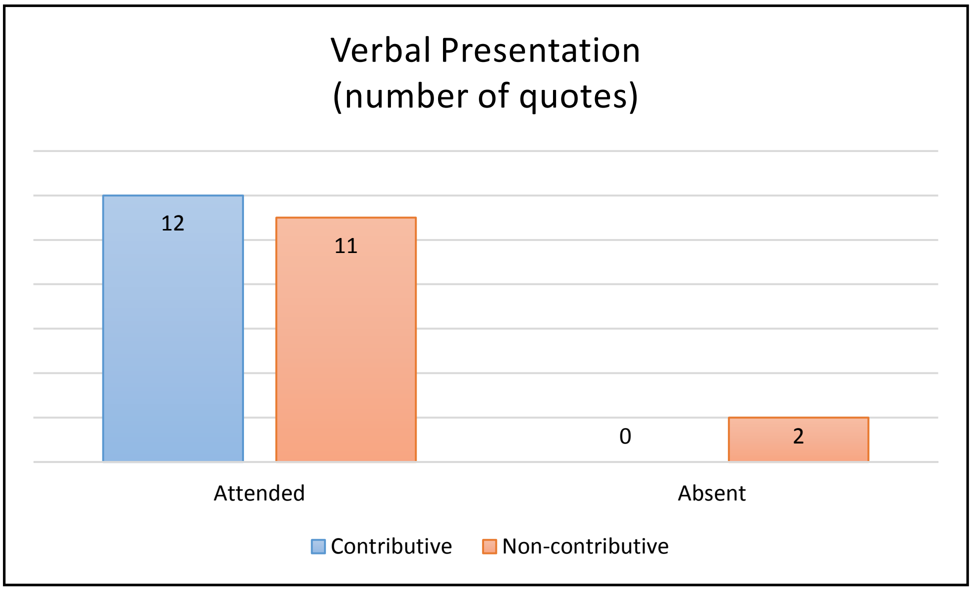


Figure 7.31: Contribution of the verbal presentation semiotic tool (Cycle 2)

The verbal presentation semiotic tool contributed to the semiotic transference process by supporting the establishment of verbal link between the theoretical concept and the sign. The success of this tool relies on its integration with the other three main modal principles. The semiotic process can be further enhanced by encouraging the participants to verbally engage with their own learning process, shifting the focus from a lecturer directed learning process towards a collaborative knowledge transfer process. The collaborative knowledge transfer process will mediate the verbal and language challenges the participants experienced.

c) *Direct presentation*

The influence of the direct presentation semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.18).

Table 7.18: Contribution of the direct presentation semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycle 1.	The practical/physical implementation of step 2 in the Design Knowledge Semiotic Process (Figure 6.2) facilitated the conceptualisation process between the theoretical concept and a context specific icon.	**	*And yesterday I was mostly helped by the visual clues[39]. I saw symmetry and asymmetry in a more practical way. I was able to differentiate between the two because I saw them in a practical way* (18)
Contributive: Iterative cycle 2.	The physical interaction between the natural environment and the theoretical concept created a resource of context specific information.	****	*The information about the nature, it gave the true reflection through the leaves. We went out and picked the leaves and most of them were showing the exact reflection* (14)
	Implementing the intervention in an outdoor natural environment facilitated the semiotic transference process.	**** ****	*We saw things from nature, unlike before. Before it was just the pictures. And even with the pictures we didn't really*

[39] Context specific icon.

			understand what they were portraying or - but then this work this time around we had (group interview) *the nature did help. For example, we were asked to get something that was showing, rotation. So we went around the campus then we found a flower with rotation* (6)
	The outdoor natural environment provided authentic context specific visual resources.	**** ***	*Then what also helped me is nature because when the lecturer made examples he made examples of nature and so we could see examples of nature* (4)
	Grounding the contextualisation process firmly into a domain specific context.	*	*Like we realised that the designing is not only about, like actually drawing or whatsoever. It's our everyday life. It's about everything that we see* (group interview)
	Linking their study field, Landscape Architecture, with the theoretical contents and the domain specific context.	**	*What was important because of nature is that it made me to understand that the landscape, it's all about the study of the outdoors* (17)
Non-contributive[40] Iterative cycle 2.	Unable to comprehend the relevancy of nature (specific context) in the learning process.	****	*I couldn't understand what nature had to do with what we were expected to do. So like, the lecturer asked us to pick up leaves and relate to them with this activity that we were doing. So to me that wasn't helpful because a leaf wasn't relevant enough for me. So I found it very difficult* (2)
	Nature as a teaching and learning environment created a sense of confusion and not knowing what to expect.	**	*But now we were told to go outside and then outside the lecturer told us to look at the nature, to look at the symmetry of the nature and then I tried to do that one but also I couldn't get – I saw - how was it but I didn't have the, a clear image of like how is it going to be* (15)
	Moving from a traditional classroom environment, which is safe and private, to an outdoor natural environment, exposed to natural elements and social interaction, created a sense of social exposure.	*	*And another thing that makes it not to enjoy the part of picking leaves is that people were moving around. They see us in another way* (10)
	The outdoor natural learning environment also challenged them physically and exposed them to natural elements.	**	*What I didn't like was when we had to take examples from the nature, like running around taking* (19) *When we first went out it was very cold. So I was like, oh I just want to stand in the sun but now we have to go around looking for something. I was just going to stay in one position* (group interview).

[40] There were no non-contributive recurring contributions from iterative cycle 1.

The analysis of quotes relating to the contribution of the direct presentation semiotic tool indicated that there was a high (75%) combined contribution[41] to the semiotic contextualisation process.

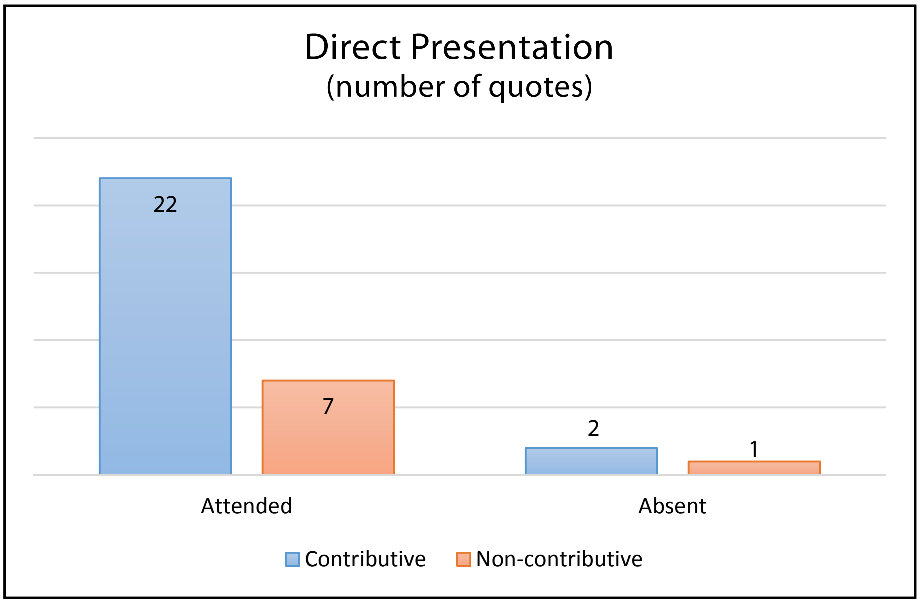


Figure 7.32: Contribution of the direct presentation semiotic tool (Cycle 2)

The direct presentation semiotic tool contributed to the semiotic transference process by supporting the semiotic contextualisation of the theoretical concept into a context specific icon[42], grounding the contextualisation process firmly into a domain specific context. The semiotic contextualisation process can be further enhanced by: explaining why the context, the natural environment, is important to the Landscape Architecture domain; explaining the modal agency meaning making process; encouraging reflection between what they did practically and theoretically (can they create a link); differentiating between different concepts and, finally, regulating external environmental influences (weather and social effects).

d) Indirect representation

The influence of the indirect representation semiotic tool on the semiotic de-contextualisation process was classified as either contributive or non-contributive (Table 7.19).

Table 7.19: Contribution of the indirect representation semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycle 1.	Created both, visual and cognitive links between the theoretical concept and a direct abstract symbol.	*****	*we were asked to draw rotational symmetry* [theoretical concept] *whereby one of the group members were to lie down and then we draw her. We'd make an image of her actually down* [direct abstract symbol] *on the tar road so that*

[41] Both contributive and non-contributive.

[42] Step 2 of the modal agency meaning making process

			was actually helpful to me because I got, when she got up I got to see the image more clearer (2)
Contributive: Iterative cycle 2.	Semiotic transference between the theoretical concept and the immediate object (Figure 6.2) was effective enough so that the participants could remember the direct symbol and de-contextualise it into an abstract symbol.	****	*And I also <u>remembered</u> the physical activities, drawings*[43] *and the nature that we saw outside from yesterday* (18) *The drawing of the leaf reflection and the tree. First the leaf reflection helped me just to see the mirror effect because I had to draw* [abstract symbol] *me pattern the other student have to draw [abstract. And the tree, we had to do a asymmetrical drawing and a symmetrical drawing of a tree and that was very helpful because now I can see the difference between those two* (23)
	Semiotic transference was enhanced through the co-implementation of the other interventions, indicating the positive contribution the intervention had on the interpretation process.	**** ***	*The drawings as well helped me and the visual clues that we did yesterday and the lecture and the notes* (12) *But once we did the physical activity and the drawing and the group-work, then I got to see what the lecturer was talking about in class and what the notes meant* (1).
Non-contributive[44]: Recurring from iterative cycle 1.	Underdeveloped ability to create a visual and cognitive link between the theoretical concept and an abstract symbol and then de-contextualise it into an abstract indirect representation.		
Non-contributive: Iterative cycle 2.	Struggled to comprehend the relevancy of nature (specific context) in the learning process.	*	*And the nature of which wasn't much of help because it was just a plant that did not clearly make sense as to what I have to do but it did, kind of play a role but a smaller one* (2)

[43] The word "drawing" refers to the Icon and Direct symbol, the product not the actual activity. The activity will be discussed in the Sensory Modal Agency tool of kinesthetic drawing.
[44] There were no quotes in iterative cycle 2 referring to this influence.

The indirect representation semiotic tool only contributed 14% (Figure 7.28) to the perceived effect that the Ideational Modal Agency had on the participants, but almost all (94%) the participants indicated that this tool did contribute to their semiotic transference process. (Figure 7.33)

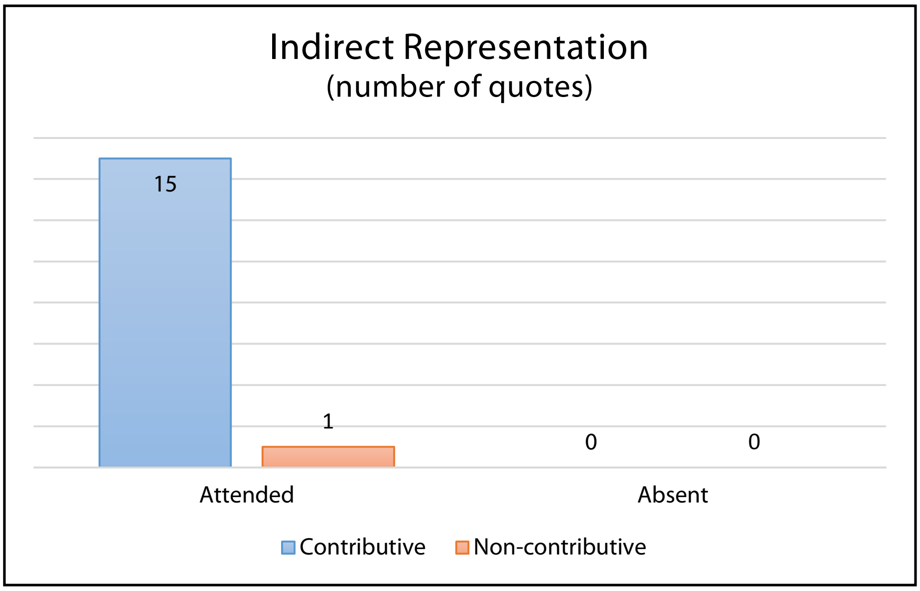


Figure 7.33: Contribution of the indirect representation semiotic tool (Cycle 2)

The indirect representation semiotic tool contributed to the semiotic transference process by supporting the semiotic de-contextualisation of the direct symbol into an abstract symbol[45]. The semiotic contextualisation process can be further enhanced by: incorporating the other semiotic tools as the facilitating agents in the semiotic de-contextualisation process and their outcomes, i.e. drawings, poses and designed artefacts, as the indirect representational products, creating a physical interpretation of the symbol and then an abstract artefact – indirect representation.

7.5.3.2. Sensory Modal Agency

The Sensory Modal Agency consists of the following semiotic tools:

- Natural iconic presentation
- Kinesthetic drawing, and
- Kinesthetic expression

[45] Step 4 of the modal agency meaning making process

Figure 7.34 indicates the percentage of quotes that relates to each participant's perspective on the influence each intervention had on his/her semiotic transference process.

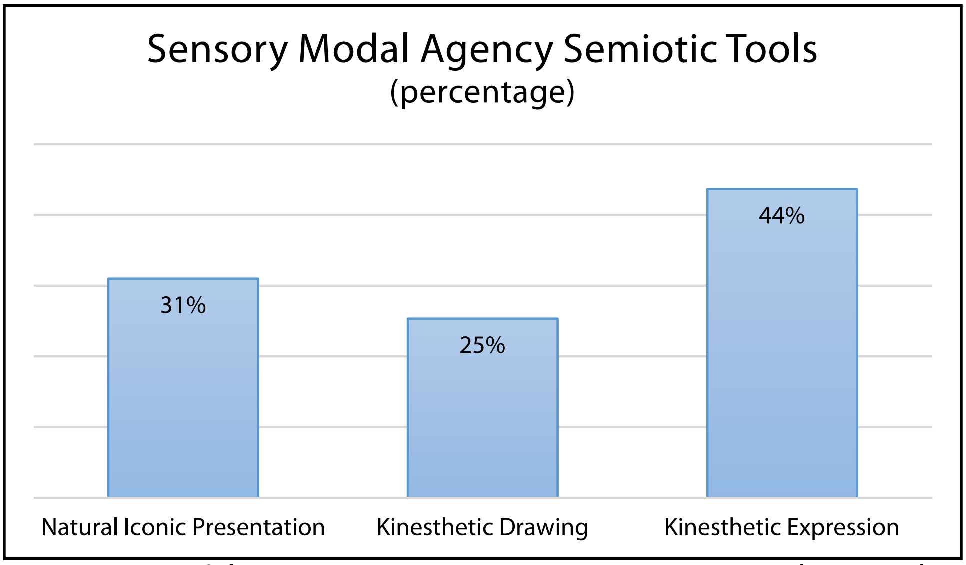


Figure 7.34: Sensory Modal Agency Sensory Semiotic Perspective Analysis (Cycle 2)

a) Natural Iconic Presentation

The influence of the natural iconic presentation semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.20).

Table 7.20: Contribution of the natural iconic presentation semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycle 1.	Created an awareness that the natural environment can be a resource of natural iconic[46] examples.	*****	*Then what also helped me is nature because when the lecture made examples he made examples of nature and so we could see examples of nature* (4)
	Encouraged the use of the natural environment as a resource of inspiration.	***	*the most important thing as the visual clues, the nature. The way that the flowers looks like it gave me enough information. Everything became clear when I saw the pictures outside and from nature* (14)
	The natural environment was used as symbol that represented the emotional challenges some of the participants faced during the design process.		
Contributive: Iterative cycle 2.	The intervention assisted in the recollection process and created external visual prompts to the theoretical concepts.	***	*The nature also helped me a lot because I was able to remember what I saw and be able to do the class activity* (4) *Outside the classroom I saw the trees that were faced opposite. And then there was a picture on the board that was written about the trees, they were standing opposite* (10)
	Provided a practical context specific platform where the semiotic contextualisation process can be implemented.	******	*And yesterday I was mostly helped by the visual clues. I saw symmetry and asymmetry in a more practical way. I was*

[46] Iconic refers to the resemblance or imitation of the object (theoretical concept) by looking exactly like it (i.e. photograph) in nature.

			able to differentiate between the two because I saw them in a practical way (18) *I want to see and do the work. Like if you talk about a tree show us how to, how – first examples of a tree so I can do and then from that I can learn from that something* (23)
Non-contributive[47]: Iterative cycle 2.	Nature was seen as not a valid resource of information.	*****	*What didn't help me the most was the nature* (1) *And I wouldn't say nature helped me a lot. Like it didn't matter so much to me to look at the nature and things. As you can see that is the least of my circles*[48] (8)

The natural iconic presentation semiotic tool contributed 31% (Figure 7.34) to the perceived effect that the Sensory Modal Agency had on the participants, and 77% of the participants indicated that this tool did contribute to their semiotic transference process (Figure 7.35). Only five quotes of a total of 22 quotes indicated a non-contribution.

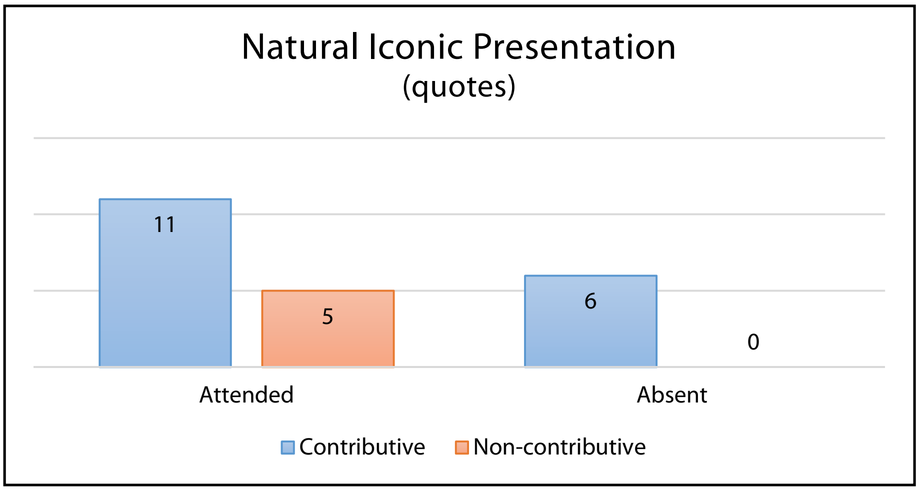


Figure 7.35: Contribution of the natural iconic presentation semiotic tool (Cycle 2)

The natural iconic presentation semiotic tool contributed to the semiotic transference process by providing a practical context specific platform for physical and natural resources in the creation of natural iconic examples. The semiotic contextualisation process can be further enhanced by: explicitly explaining the importance of the link between the theoretical concept and the context, and nature must be the primary contextualisation resource.

b) Kinesthetic drawing

The influence of the kinesthetic drawing semiotic tool[49] on the semiotic de-contextualisation process, as applied in conjunction with the indirect representation semiotic tool, was classified

[47] There were no non-contributive recurring contributions from iterative cycle 1.
[48] Referring to the circle sizes of the Venn diagram, i.e. small circles represented a low contribution.
[49] Step 3 and 4 of the modal agency meaning making process.

as either contributive or non-contributive. There were, however, only contributive quotes for this intervention (Table 7.21).

Table 7.21: Contribution of the kinesthetic drawing semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[50]: Iterative cycle 2.	Created physical and context specific visual links between the theoretical concept and sign.	*********	*The one which helped me the most was when someone had to lie down and we drew with the chalk* (Figure 7.23)(group interview) *"that drawing,[51] it represent the rotation symmetry. That's where I get it* (22)
	Created the environment where the participants were encouraged to actively participate in the interpretation process.	****	*Then the drawing, the drawings were fun and were easy to understand* (6) *Also the drawings, when we were drawing I got more information* (4)
	Facilitated collaborative learning activities.	**	*But once we did the physical activity and the drawing and the group-work, then I got to see what the lecturer was talking about in class and what the notes meant* (1)
	Created the environment that supported development of self-perceptions regarding creative competency.	***	*But what helped me were the drawings that we did. The drawings helped me because they explained things that the lecturer could not explain further, but the drawings did* (9)

The kinesthetic drawing semiotic tool contributed 25% (Figure 7.34) to the perceived effect that the Sensory Modal Agency had on the participants. All the participants indicated that this tool did contribute to their semiotic transference process (Figure 7.36). This semiotic tool had no perceived influence on the absent participants' semiotic transference process.

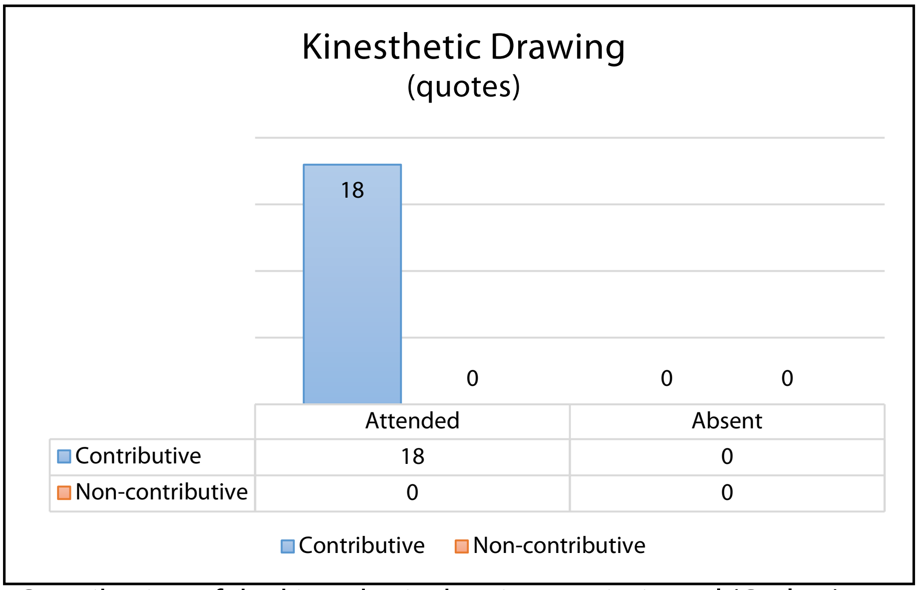


Figure 7.36: Contribution of the kinesthetic drawing semiotic tool (Cycle 2)

[50] There were no contributive recurring contributions from iterative cycle 1.

[51] The word "drawing" refers to kinesthetic activity, the physical process of drawing using the whole body to draw and not the Icon and Direct symbol.

The kinesthetic drawing semiotic tool facilitated the semiotic de-contextualisation process through the creation of physical and practical visual links, encouraged active participation in the interpretation process and facilitated learning through the interaction between their physical bodies, conceptual environment and physical/natural environment. The semiotic re-contextualisation process can be further enhanced by aligning each drawing assignment to specific theoretical concepts and by encouraging all the participants to individually engage with each drawing assignment.

c) Kinesthetic expression

The influence of the kinesthetic expression semiotic tool[52] on the semiotic de-contextualisation process, as applied in conjunction with both the indirect representation (7.5.3.1.d) and emotional group-work (7.5.3.4.a) semiotic tools, was classified as either contributive or non-contributive (Table 7.22).

Table 7.22: Contribution of the kinesthetic expression semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycle 1.	The physical/kinesthetic implementation of steps 4 and 5 in the modal agency meaning making process (Figure 6.4) facilitated the de-conceptualisation process from the Direct Symbol to the Abstract Symbol and Interpretation.	**** **** *	*So we discussed it*[53] *and then after discussing it I had a clear picture*[54] *of what it was all about. Then when we do the physical activities, the poses that we did also gave me a clear view of what we were doing. They show that what was told visually and so it was done physically* (6)
Contributive: Iterative cycle 2.	The physical/kinesthetic implementation of steps 4 and 5 in the in the modal agency meaning making process (Figure 6.4) supported the recollection of theoretical concepts by referring back to the physical activities.	****	*It's important because we did the physical activities that I could easily remember the poses that we were doing. I'll never forget those struggles to remember than the notes we had to read and then we have to read it again, where we have to remember what you read on the notes. So physically it's just easy to remember* (15).
	Encouraged active participation in the interpretation process and enhanced their understanding of the theoretical concepts.	**** *	*So working together physically helps you to understand much better than sitting at home or sitting in class alone and studying* (group interview) *Then the physical activities that we did yesterday, they really helped me, more especially the poses* (Figure 7.25). *They helped me understand the translation symmetry* (14)
	Created a safe supportive environment for creative expression and experimentation.	**	*The activities helped me a lot… we had to make shapes with our shadows outside and sometimes the shadows won't be like perfect how you want it. But we manipulated the shadows so we can have the perfect shape that we wanted to do asymmetrical* (23)

[52] Step 4 and 5 of the modal agency meaning making process.
[53] Step 2 of the modal agency meaning making process.
[54] Step 3 of the modal agency meaning making process.

	Enhanced an individual's self-efficacy and creative self-confidence to be more willing to participate.	***	*last time I didn't understand this thing. But today it was a bit clear because the stuff, then we also go outside mos and then we do some participant exercises… was a bit of fun and also we were educated so it's like we got more information by having fun* (22)
	The co-implementation of the other semiotic tools not only facilitated the semiotic transference process, but also strengthened some of the weaker semiotic links created by other interventions.	******	*But once we did the physical activity and the drawing and the group-work, then I got to see what the lecturer was talking about in class and what the notes meant* (1) [co-implementation of other semiotic tools] *"Doing those poses I think was sort of interesting because they explained more what was said on the nature* (25)
Non-contributive[55]: Iterative cycle 2.	Resistance to physical activities	*	*The second last thing[56] was the physical activities when we were asked to lie down or someone to lie down and you do rotative symmetry, I did not like it* (20)
	The perception that physical activities could be seen as playing.	*	*So I don't like to play most of the time* (22).

The kinesthetic expression semiotic tool had the highest contribution of 44% (Figure 7.34) to the perceived effect that the Sensory Modal Agency had on the participants; 29 of the 31 quotes (94%) indicated that this tool did contribute to their semiotic transference process. (Figure 7.37):

What stood out for me? The physical activities! (7).

The kinesthetic expression semiotic tool had no perceived influence on the absent participants' semiotic transference process.

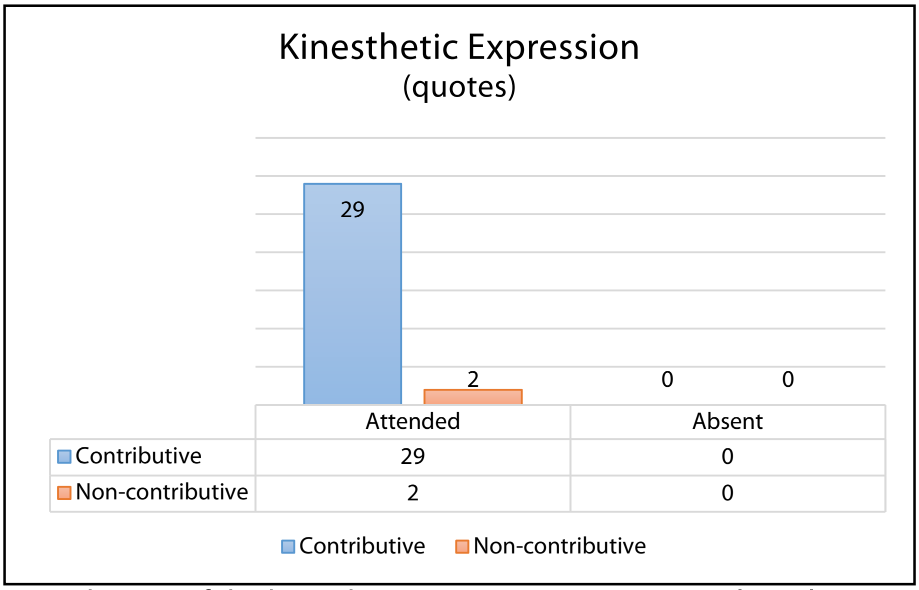


Figure 7.37: Contribution of the kinesthetic expression semiotic tool (Cycle 2)

The kinesthetic expression semiotic tool facilitated the semiotic de-contextualisation process through the physical activities, encouraged active participation in the interpretation process,

[55] There were no non-contributive recurring contributions from iterative cycle 1.
[56] Rating from most influential to the least influential.

stimulated creative exploration, enhanced the recollection of theoretical concepts and supported the semiotic transference process through the co-implementation of semiotic tools. The semiotic re-contextualisation process can be further enhanced by: explicitly explaining the importance that physical activities play during the interpretation process, by incorporating the other semiotic tools as the facilitating agents in the semiotic de-contextualisation process, and by aligning each physical activity to specific theoretical concepts and in the process encourage all the participants to engage with each physical assignment.

7.5.3.3. Logical Modal Agency

The Logical Modal Agency consisted of the following semiotic tools:

- Logical iconic presentation
- Logical symbolic representation
- Logical interpretation.

Figure 7.38 indicates the percentage of quotes that relate to each participant's perspective on the influence each semiotic tool had on his/her semiotic transference process.

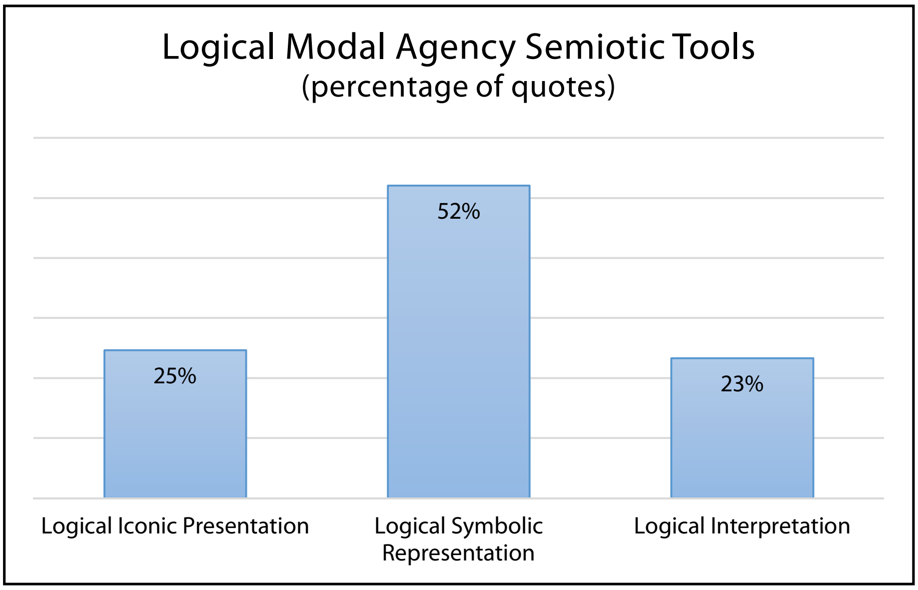


Figure 7.38: Logical Modal Agency Semiotic Tools Perspective Analysis (Cycle 2)

a) Logical iconic presentation

The influence of the logical iconic presentation semiotic tool on the semiotic contextualisation process, as applied in conjunction with both the direct presentation (7.5.3.1.c) and natural iconic presentation (7.5.3.3.a) semiotic tools, was classified as either contributive or non-contributive (Table.7.23)

Table 7.23: Contribution of the logical iconic presentation semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycle 1.	Stimulated a spatial sensitivity to visual signs.	***	*And the third thing[57] was the visual or nature. When we were asked to look around the campus and to see any symmetries we saw* (20)
Contributive: Iterative cycle 2.	This intervention, in conjunction with both the natural iconic presentation intervention (7.5.3.2.a) and direct presentation intervention (7.3.c), stimulated a spatial ability to visually identify and connect a context specific icon to a theoretical concept.	*****	*And yesterday I was mostly helped by the visual clues. I saw symmetry and asymmetry in a more practical way. I was able to differentiate between the two because I saw them in a practical way* (18)
	The practical context specific platform, provided by the natural iconic presentation intervention, created a resource for creating various context specific direct semiotic links, from basic theoretical concepts, like reflection, to more advanced theoretical concepts, like rotational symmetry.	***	<u>Basic theoretical concepts:</u> *We went out and picked the leaves and most of them were showing the exact reflection* (14) <u>Advanced theoretical concepts</u>: *Also, the nature did help. For example, we were asked to get something that was showing, rotation. So we went around the campus then we found a flower with rotation* (6)
Non-contributive: Recurring from iterative cycle 1.	Weak semiotic link between the theoretical concept and the context specific icon, thus difficulty remembering the theoretical concept.	*	*The tree, the tree wasn't like – because the tree didn't help me a lot* (23)
Non-contributive: Iterative cycle 2.	Nature was seen as not a valid resource of information (same as the natural iconic presentation intervention).	***	*I couldn't understand what nature had to do with what we were expected to do. So like, the lecturer asked us to pick up leaves and relate to them with this activity that we were doing* (2)
	Low spatial sensitivity to visual signs, unable to link a theoretical concept to a context specific sign.	**	*we were told to go outside and then outside the lecturer told us to look at the nature, <u>to look at the symmetry of the nature and then I tried to do that one but also I couldn't get</u> – I saw - how was it but I didn't have the, a clear image of like how is it going to be* (15)

This semiotic tool only contributed 25% (Figure 7.38) to the perceived effect that the Logical Modal Agency had on the participants; 12 of the 18 quotes (67%) indicated that this tool contributed to their semiotic transference process (Figure 7.39).

[57] Rating from most influential to the least influential.

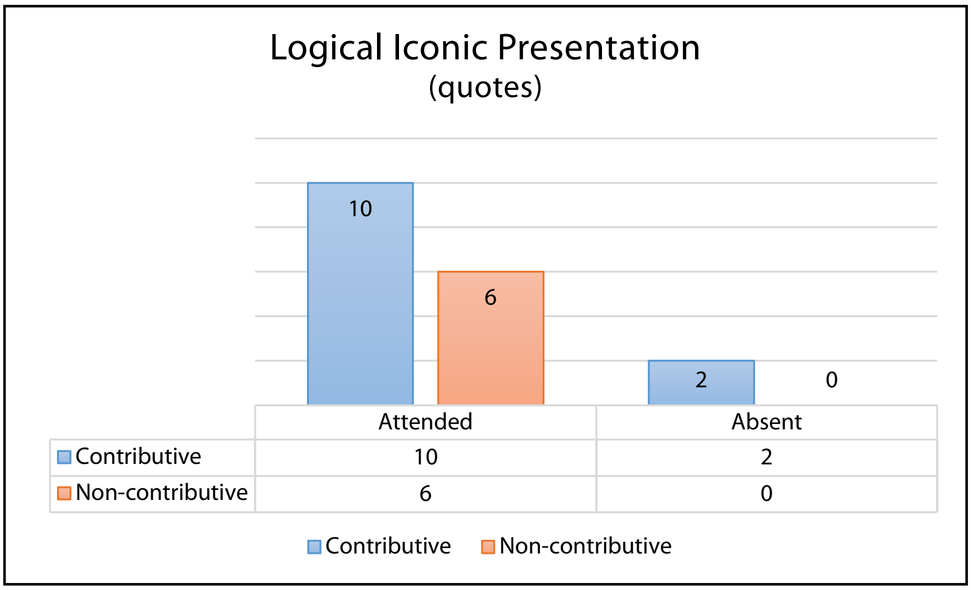


Figure 7.39: Contribution of the logical iconic presentation semiotic tool (Cycle 2)

The logical iconic presentation semiotic tool assisted the semiotic contextualisation process by the stimulation of a spatial ability to visually identify and connect a context specific icon to a theoretical concept. The semiotic contextualisation process can be further enhanced by: developing and strengthening the context specific platform, and by facilitating opportunities to create more basic visual connection activities between the theoretical concept and a context specific icon.

b) Logical symbolic representation

The influence of the logical symbolic presentation semiotic tool on the semiotic re-contextualisation process, as applied in conjunction with both the indirect representation (7.4.3.2.d) and the logical interpretation (7.4.3.3.c) semiotic tools, was classified as either contributive or non-contributive (Table 7.24).

Table 7.24: Contribution of the logical symbolic representation semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycle 1.	Visual and verbal analogies supported the re-contextualisation transference between the Abstract Symbol and the Abstract Interpretation, and stimulated the recollection of the theoretical representamen.	*********************	*And then the words*[58]*. The word that was written opposite twins* [verbal analogy] *and the picture of it* (Figure 7.40), *of the twins that were opposite helped me to, helped me in reflection* [theoretical concept]*… the pictures and also the picture that had leaves on it* [visual analogy] (Figure 7.41) *also helped me with the reflection because there were opposite leaves* (6)
Contributive: Iterative cycle 2.	The context specific representamen[59] supported the semiotic transference between step 4 and step 5 of the modal agency meaning making process (Figure 6.3); for example, participant 14	***************	*a visual clue of which it was a car emblem, the BMW. So it helped me realise the radial symmetry. And it somehow shows the motion because in that emblem we have*

[58] In class, stage 2 of the intervention

[59] All three types of signs: the icon, the index and the symbol.

	referred how the link[60] between the theoretical concept (radial symmetry) and the indirect Symbol (BMW car emblem) helped him.		*the circle at the centre and then the other pieces that are trying like around* (14)
Non-contributive[61]: Iterative cycle 2.	Unable to apply the geometric shapes to re-contextualise an Abstract Symbol to an Abstract Interpretation.	**	*And then in class – but the shapes I didn't know what to do about the shapes* (12)

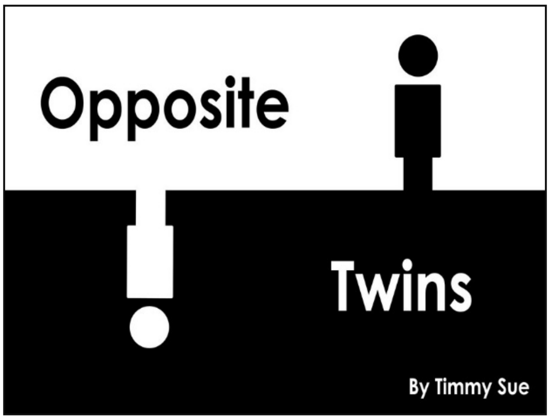


Figure 7.40: Verbal and visual analogy example of reflection symmetry.
Source: www.timmytheazn.deviantart/art)

Figure 7.41: Visual analogy example of reflection symmetry.
Source: www.rickbethem.com

This semiotic tool had the highest contribution (52%) (Figure 7.38) to the perceived effect that the Logical Modal Agency had on the participants; 36 of the 38 quotes (95%) indicated that this tool contributed to their semiotic transference process (Figure 7.42).

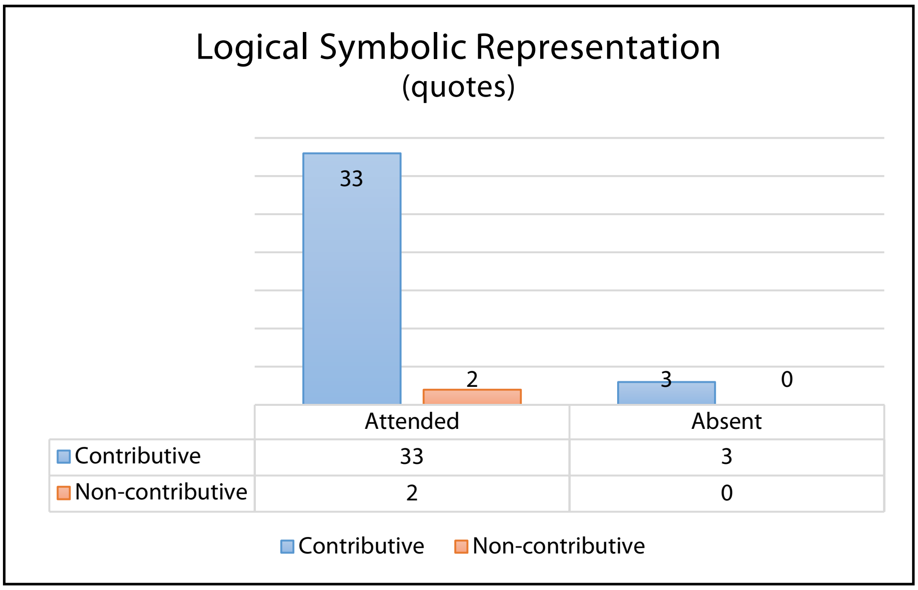


Figure 7.42: Contribution of the logical symbolic representation semiotic tool (Cycle 2)

The logical symbolic representation semiotic tool assisted the semiotic re-contextualisation by accessing context specific theoretic symbolic representamen to support transference between

[60] Step of the modal agency meaning making process.
[61] There were no non-contributive recurring contributions from iterative cycle 1.

the Abstract Symbol and Abstract Interpretation, and assisted recollection of the Abstract Symbol through visual and verbal analogies. The semiotic contextualisation process can be further enhanced by: encouraging the development of various abstract symbols for each theoretical concept and reducing the context specific, directing representational visual and verbal analogies and by introducing more abstract and domain specific visual and verbal analogies.

c) Logical interpretation

The influence of the logical interpretation semiotic tool (only implemented during stage 2 of the intervention) on the re-semiotisation and re-contextualisation process was classified as either contributive or non-contributive (Table 7.25).

Table 7.25: Contribution of the logical interpretation semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycle 1.	Supported the re-contextualising of the context specific theoretic symbolic representamen[62] into an abstract artefact, for example connecting an abstract visual analogy (the feathers of a bird) into a domain specific context (design of a walkway).	*******	*And then today the pictures, such as the birds, the bird spreading its feathers and the picture of something that looks like a walkway with different kind of symmetries* (11)
	The geometric shapes simplified this process, encouraging experimentation for different design solutions and stimulated creative expression.	***	*And then we should give some ideas of being creative. How to, how are we going to combine those shapes to come up with something and then we can copy some of them* (19)
Contributive: Iterative cycle 2.	Visual and verbal analogies acted as resources for inspiration and direction.	*****	*Because they are the ones that helped me the most because if I'm confused I would look on the board and look for the clue on what to do so they helped me the most* (16)
	The implementation of both visual and verbal analogies stimulated recollection of existing semiotic transference processes.	******	*We had pictures* [visual analogy] *on the wall all over the class and that was the major thing that helped me because from those pictures <u>I could go back to remembering what we did yesterday</u> and I could see from the pictures the types of symmetry that we used. And then, ja I got an idea and went back to yesterday's activities* (2)
Non-contributive: Recurring from iterative cycle 1.	The use of geometric shapes to re-contextualise an Abstract Symbol to an Abstract Interpretation restricted the creative process.	*	*I thought about many ideas but then the shapes were only three, four shapes. So they didn't help me much* (17)
Non-contributive: Iterative cycle 2.	Some of the verbal analogies were not clear and had been perceived as limiting.	**	*"What was not clear is the quotes* (12); and *And then the words were also there but they didn't do much justice to what I wanted to do* (2)

[62] All three types of signs: the icon, the index and the symbol

This semiotic tool had the lowest contribution (23%) (Figure 7.38) to the perceived effect that the Logical Modal Agency had on the participants; however, 21 of the 23 quotes (91%) indicated that this tool contributed to their semiotic transference process (Figure 7.43).

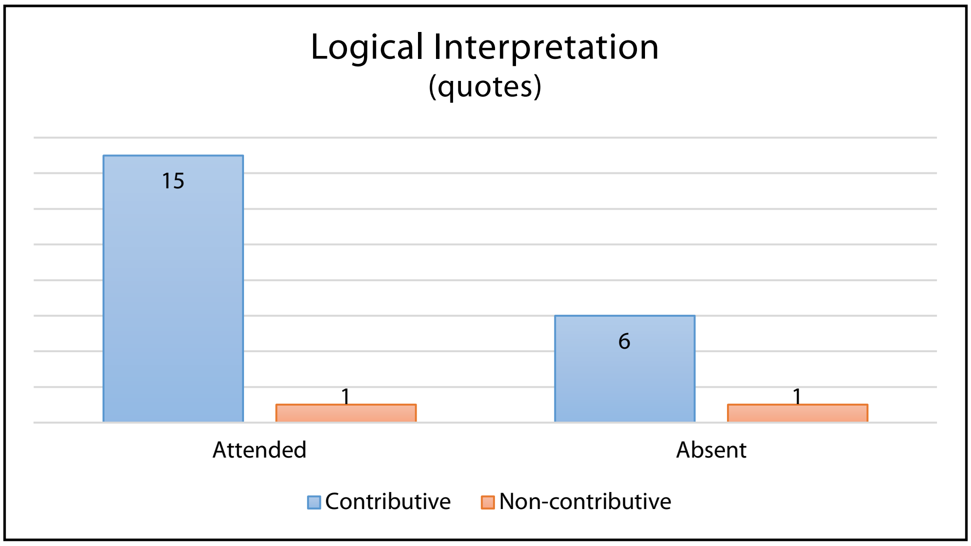


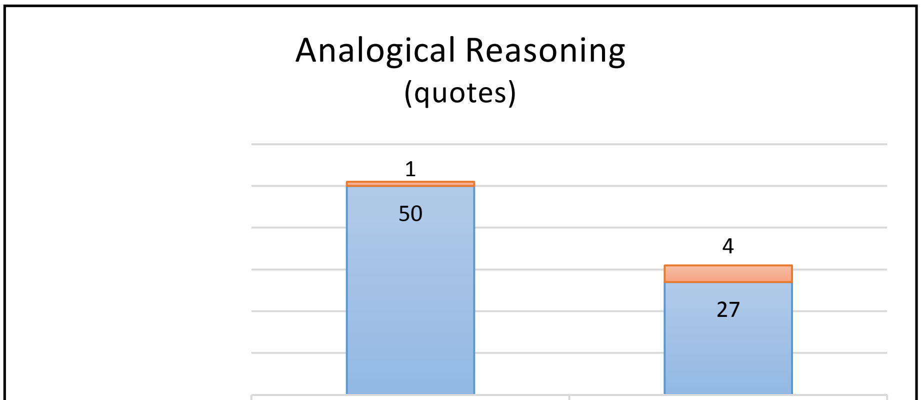
Figure 7.43: Contribution of the logical interpretation semiotic tool (Cycle 2)

Visual analogy contributed 62% to the perceived contribution that the analogical reasoning methods prompted representational shift in the semiotic transference process (Figure 7.44):

> *it's the picture that, there were trees and that were the opposite of each other. So they made a reflection so those are the picture that makes me understand* (15).

Verbal analogy's contribution was a little less (38%), but still valid:

> *Also the words, more specifically the words that are, the picture of the words that are big and others are small. The picture of the words that has symmetry and all of that. So that's basically what helped me with things* (4).



	Visual Analogies	Verbal Analogies
Non-contributive	1	4
Contributive	50	27

Figure 7.44: Contribution of the analogical reasoning semiotic tool (Cycle 2)

The logical interpretation semiotic tool assisted the re-semiotisation and re-contextualisation process by the creation of abstract artefacts and the implementation of analogical reasoning methods and stimulated the semiotic recollection and re-contextualisation. The semiotic re-contextualisation process can be further enhanced by: implementing various design assignments to de-contextualise and re-semiotise various representamen into abstract artefacts and restrict direct representational and context specific visual and verbal analogies, and by introducing more abstract and domain specific visual and verbal analogies.

7.5.3.4. Emotional Modal Agency

The Emotional Modal Agency consisted of the following semiotic tools:

- Group-Work
- Friends/peers discussion
- Individual reflection
- Self-Study.

Figure 7.45 indicated the percentage of quotes that relates to each participant's perspective on the influence each semiotic tool had on his/her semiotic transference process.

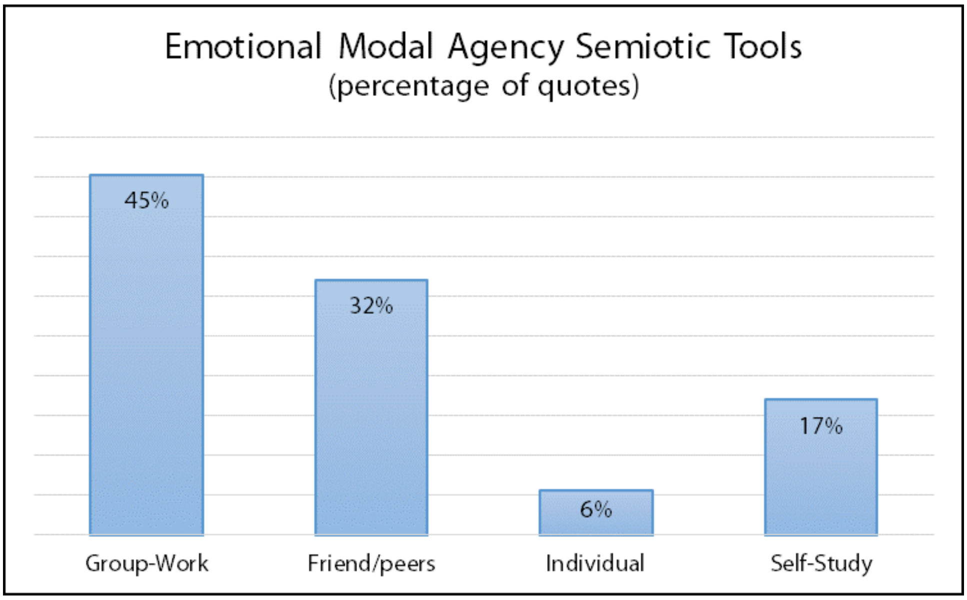


Figure 7.45: Emotional Modal Agency Semiotic Tools Perspective Analysis (Cycle 2)

a) Group-Work

The influence of the group-work semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.26).

Table 7.26: Contribution of the group-work semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions	Created an environment that encouraged collaborative learning, supporting the transference of knowledge and skills.		*Some of the things I didn't understand like translation…so we discussed it and then after discussing it I had a clear picture of what it was all about* (6)

from iterative cycle 1.	Facilitated creative interaction between group members.		*Yeah and then the group-work really helped, when we had – we when we did to demonstrate the kinds of, ja of asymmetry and symmetrical methods* (1)
Contributive: Iterative cycle 2.	Collaborative learning created a supportive learning environment and created a sense of belonging.		*And group-work helped me as well because there we got to explain to each other and we combined our ideas when the other group member was confused and then we got a clear picture of what we were to do and present to the lecturer and other students* (2) *Oh, what I want to say is the physical work*[63] *that we did yesterday helped us to get to know one another. Yes. Improve our relationship as a family* (group interview)
Non-contributive[64]: Iterative cycle 2.	A resistance to working in groups.		*I didn't like the group-work we did* (9)

This semiotic tool had the highest contribution (45%) (Figure 7.45) to the perceived effect that the Emotional Modal Agency had on the participants; 20 of the 24 quotes (83%) indicated that this tool contributed to their semiotic transference process (Figure 7.46):

> *Outside the class the group-work actually helped me a lot. Like it helped me understand radial asymmetry like as a group and that helped me like I gained more information from that* (9).

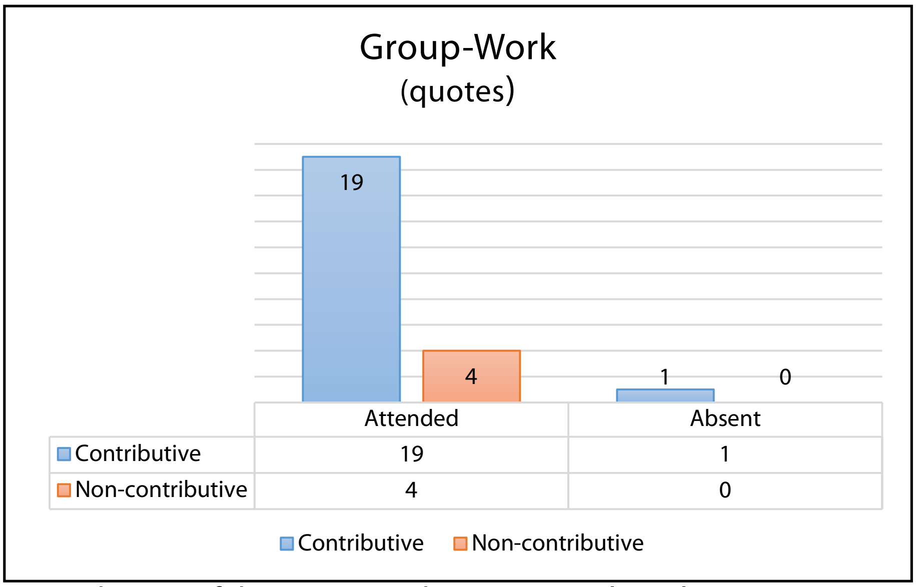


Figure 7.46: Contribution of the group-work semiotic tool (Cycle 2)

The group-work modal intervention acted as a facilitation agent that assisted the semiotic processes of theoretical concepts by facilitating knowledge transference activities and created

[63] Group activity.
[64] There were no non-contributive recurring contributions from iterative cycle 1.

a supportive environment for collaborative learning processes. The semiotic contextualisation process can be further enhanced by: enable the group to facilitate different activities in different theoretical concepts, incorporate group-work in all the steps of the modal agency meaning making process and change the sizes of the groups, vary the sizes from groups of two not bigger than six.

b) Friends/peers discussion

The influence of the friends/peers semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.27).

Table 7.27: Contribution of the friends/peers discussion semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycle 1.	The verbal resources of 'others' supported semiotic transference between the theoretical concept and the sign.	***	*My friend helped me the most because she explained to me about the symmetry and she also explained to me the types and how it works* (17)
	Encouraged collaborative learning through the creation of a supportive social environment.	*	*my friends because they are the ones that helped me the most yesterday in understanding the topic that are based on, the topic that we are based on now* (4)
Contributive: Iterative cycle 2.	Assisted the absent participants' semiotic transference by providing theoretical resources.	***	*what helped me are the notes, which I was given by a friend. They helped me a lot because I was able to remember* (16)
	Facilitated collaborative learning by extending the learning process into a social environment.	*	*And then friends, for explaining the work and showing some of their drawings* (11)
	Sustained the semiotic transference by assisting recollection.	*	*And remembering because if I didn't remember what was explained to me by my peer I wouldn't - be possible for me to do the class activity* (16)
	Instigating active interaction with the meaning making process.	*	*They would explain, okay, like we have to do that and that and that. Okay, like I know okay this is what we shall do* (9)
Non-contributive[65]: Iterative cycle 2.	Insufficient information from friends.	*****	*Like when we are asked like to do a task, I would ask the friends what are we supposed to do… friends didn't help me, they wouldn't give that much information* (20)
	Friends could not successfully explain the theoretical concepts.	**	*The friends, they tried to help me but they weren't like successful as the lecturer* (23)

This semiotic tool contributed (32%) (Figure 7.45) to the perceived effect that the Emotional Modal Agency had on the participants. Although10 of the 17 quotes (59%) indicated that this tool contributed to their semiotic transference process (Figure 7.47), it was mostly the absent participants (6 of the 10 quotes) who reflected the effect as contributive:

[65] There were no non-contributive recurring contributions from iterative cycle 1.

So my friends who were in class helped me and told me what the lecturer said at that time that I was not here (4).

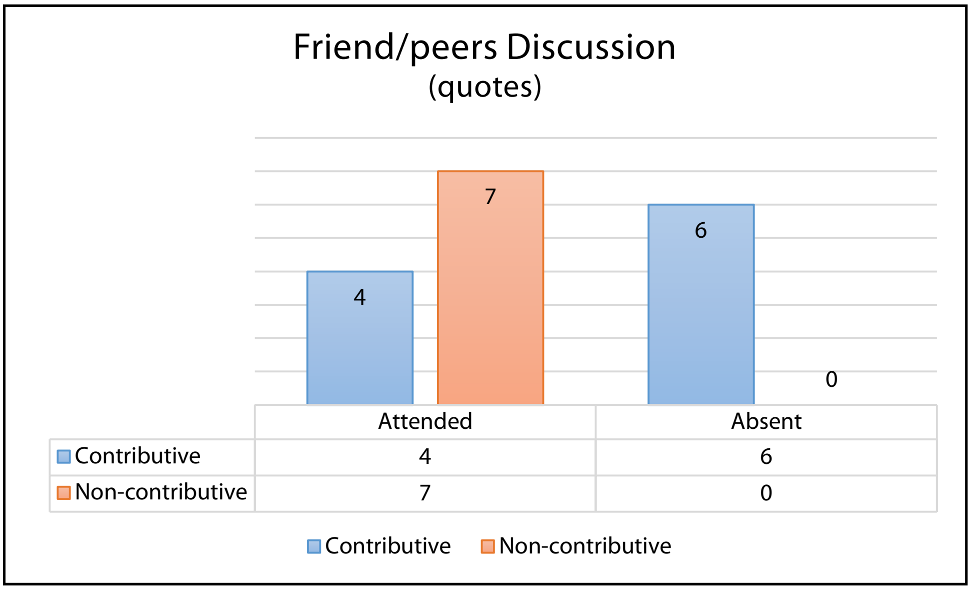


Figure 7.47: Contribution of the friends/peers discussion semiotic tool (Cycle 2)

The friends/peers discussion semiotic tool acted as a facilitation agent that assisted the semiotic processes of theoretical concepts by providing the resources of 'others', facilitated extended and collaborative learning, and created a prompting and reflective resource. The semiotic contextualisation process can be further enhanced by: encouraging the use of friends/peers as an important information resource, and by creating a collaborative learning and reflective environment that encourage friends/peers to assist in explaining the theoretical concepts, but also in reassessing how that knowledge was perceived.

c) *Individual reflection*

The influence of the individual semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.13).

Table 7.28: Contribution of the individual reflection semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[66]: Iterative cycle 2.	Encouraged the individual to actively participate in his/her own learning process.	**	*Also the drawings, when we were drawing I got more information. I understood it even more when I was drawing by myself* (4)
Non-contributive: Recurring from iterative cycle 1.	Working individually was perceived to limit creativity and non-contributive to the semiotic transference process.		
Non-contributive:	Failure to comprehend the relevancy of nature (specific context) the same as the natural iconic intervention; both of	*	*The tree, the tree wasn't like – because the tree didn't help me a lot but it showed me the, how the different balance between*

[66] There were no contributive recurring contributions from iterative cycle 1.

Iterative cycle 2.	them were implemented during the same activity.		*the trees because you can see the horizontal and the vertical balance in it* (23)

This semiotic tool had the lowest perceived effect (6%) (Figure 7.45) on the contribution that the Emotional Modal Agency had on the participants; one of the two quotes (67%) indicated that this tool contributed to their semiotic transference process (Figure 7.48). It had no perceived effect on the absent participants.

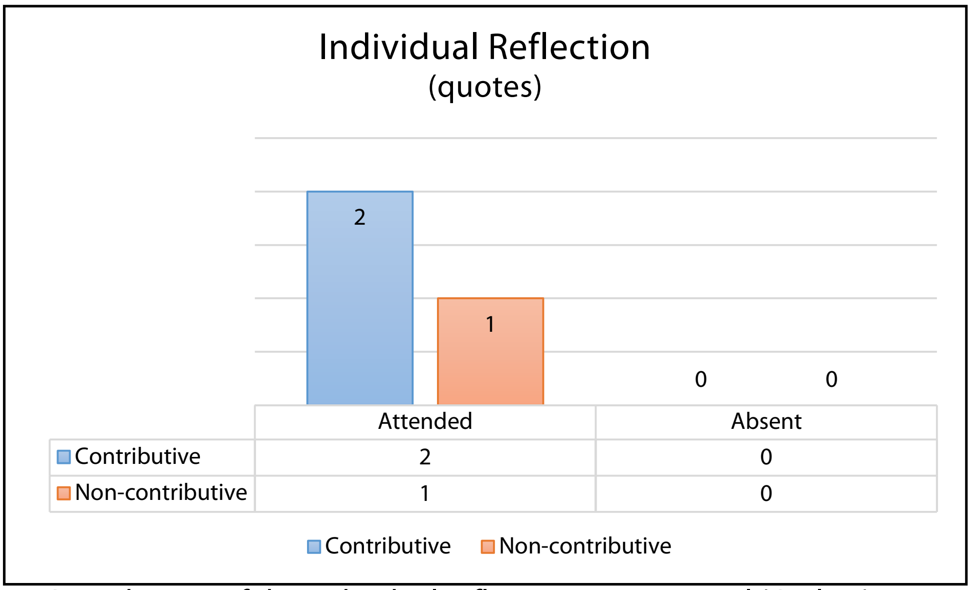


Figure 7.48: Contribution of the individual reflection semiotic tool (Cycle 2)

The individual reflection semiotic tool encouraged the reflection of the individuals' existing resources of knowledge and incorporate that to facilitate their own semiotic process. The semiotic contextualisation process can be further enhanced by: encouraging the implementation of this intervention in all the steps of the modal agency meaning making process, and creating a platform to incorporate this intervention as an enabling agent in the semiotic contextualisation process.

d) Self-Study

The influence of the self-study semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.29).

Table 7.29: Contribution of the self-study semiotic tool (Cycle 2)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[67]: Iterative cycle 2.	Encouraged and facilitated extended individual learning.	**	*So with the notes I read yesterday and today before coming to this class, so it's the one, very important* (11).
Non-contributive[68]:	The theoretical content course material did not support self-study.	*****	*The activities that we did yesterday, the least thing that helped me is the notes, I didn't understand the notes clearly. I*

[67] There were no contributive recurring contributions from iterative cycle 1.
[68] There were no non-contributive recurring contributions from iterative cycle 1.

Iterative cycle 2.			*needed to re-read it again and it was not well presented on the pictures that we were given as examples* (12).

This semiotic tool only contributed 17% (Figure 7.45) to the perceived effect that the Emotional Modal Agency had on the participants; four of the nine quotes (44%) indicated that this tool contributed very little to their semiotic transference process (Figure 7.48).

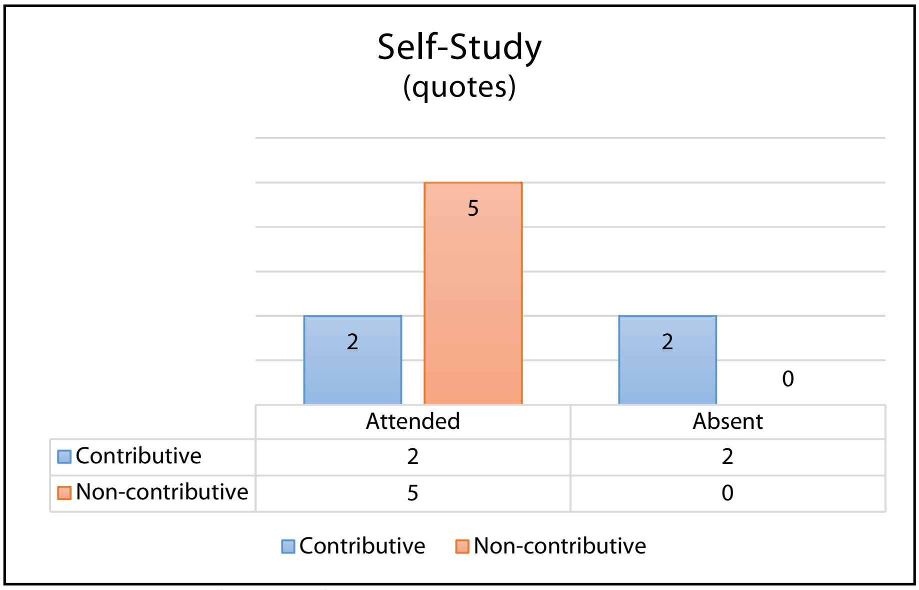


Figure 7.49: Contribution of the self-study semiotic tool (Cycle 2)

The self-study semiotic tool minimally encouraged the individual to become the facilitating agent for his/her own semiotic contextualisation process. The semiotic contextualisation process can be further enhanced by: implementing this intervention before step 1 in the modal agency meaning making process, and by encouraging the participants to individually find more resources of the theoretical concepts.

7.5.4 Overall reflection after iterative cycle 2

The qualitative data on the perceived contribution of all the Modal Agencies on each of the participant's semiotic transference process were quantified and indicated in Figure 7.50.

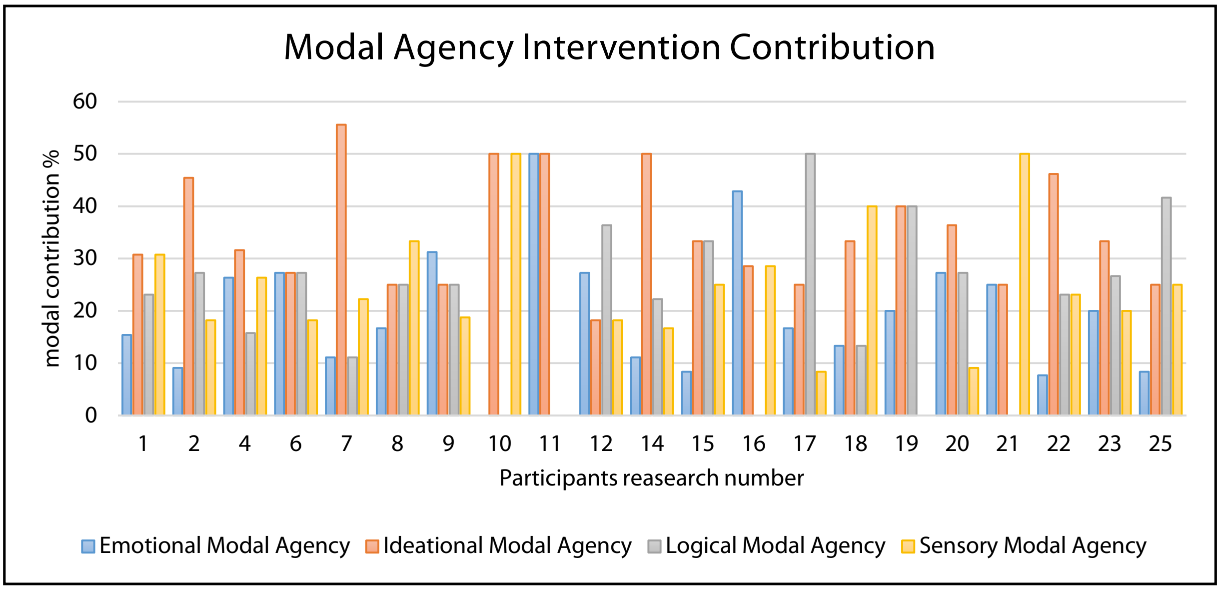


Figure 7.50: Contribution value of the modal agency intervention (Cycle 2)

The bar graph clearly indicates the contributive value variance of each semiotic tool on every single participant. Overlaying that graph with the scores from design assignment 3, indicate a correlation between the perceived contribution the Modal Agencies had and how it contributed to re-semiotisation and re-contextualisation of a theoretic concept into an abstract artefact (Figure 7.51).

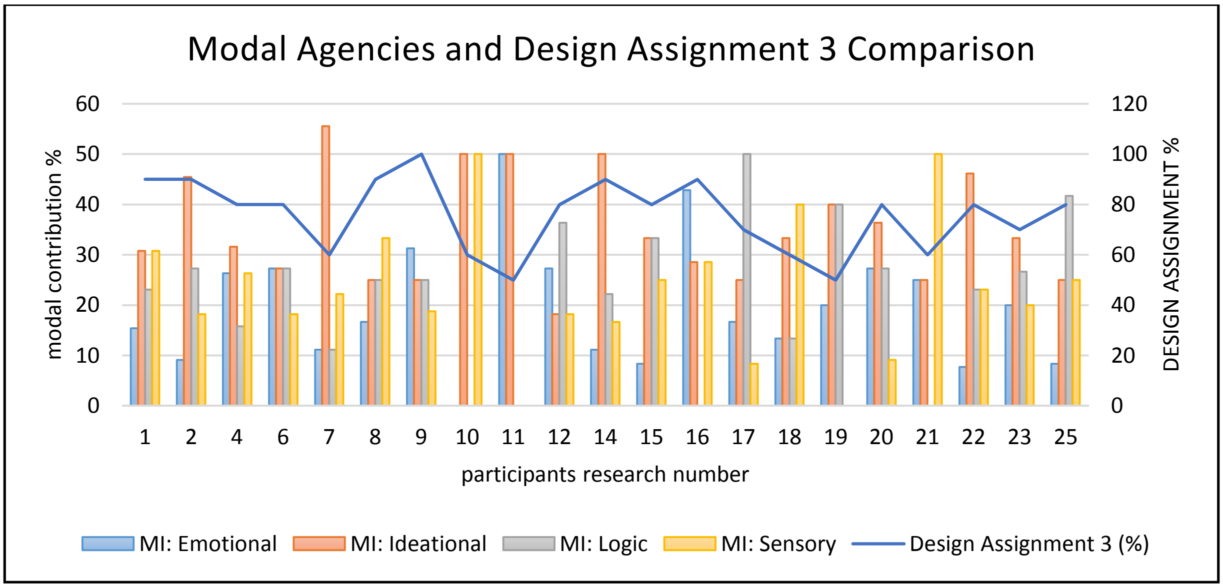


Figure 7.51: Comparison of the modal agencies with design assignment 3 (Cycle 2)

The modal agency intervention created a platform that not only contributed to each individual participant's semiotic processes, but also facilitated an authentic, domain specific, teaching and learning environment that encouraged collaborative learning.

Although the participants enjoyed the outdoor natural teaching and learning environment, some still struggled connecting the theoretical concepts to the specific environmental context and perceived the natural environment not to be a source of information.

The following issues must be addressed in iterative cycle 3 to further enhance the semiotic contextualisation process:

- Introduce more context specific and interactive visual resources in theoretical content course material;
- encourage extended individual learning and research activities;
- address the reading challenges the participants face;
- encourage the participants to verbally engage with their own learning process;
- shift the focus from a lecturer directed learning process towards a collaborative knowledge transfer process;
- explain why the context, the natural environment, is important to the Landscape Architecture domain;
- developing and strengthening the context specific platform;
- encourage reflection between what they did practically and theoretically so that they can create a link, differentiating between different concepts;
- incorporating all the interventions as the facilitating agents;
- aligning each drawing assignment to specific theoretical concepts;
- encourage all the participants to individually engage with each drawing assignment;
- encouraging the development of various abstract symbols for each theoretical concept;
- reducing the context specific, direct representational visual and verbal analogies and introducing more abstract and domain specific visual and verbal analogies;
- implementing various design assignments to de-contextualise and re-semiotise various representamen into abstract artefacts;
- enable more group activities to facilitate different activities in different theoretical concepts;
- incorporate group-work in all the steps of the Design Knowledge Semiotic Process;
- change the sizes of the groups and encourage the use of friends/peers as an important information resource;
- implementing self-study before step 1 in the Design Knowledge Semiotic Process,
- encourage the participants to individually find more resources of the theoretical concepts.

7.6 Iterative cycle 3

The third iterative cycle was implemented in July 2017 (Figure 7.52). Table 7.30 shows how meaning was transferred from the theoretical concept, for this iterative cycle 'movement and rhythm' (section 7.6.1), through the modal agency meaning making process intervention (Figure 7.2).

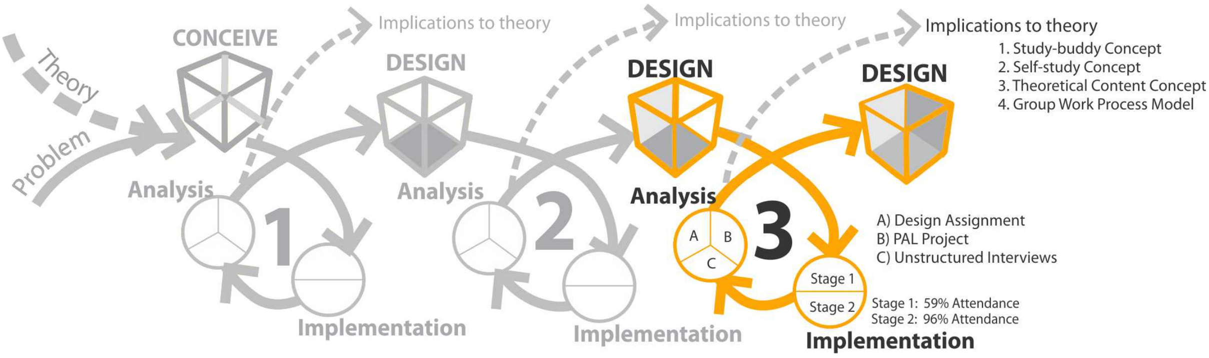


Figure 7.52: Iterative cycle 3

The following intervention concepts were developed and included in the modal agency meaning making process after the reflection and analysis of iterative cycle 2 was completed:

- *The 'Study-buddy':*
  The concept here was that each participant will be co-responsible to another participant. It was limited to two members per group. The members of the group had to be friends. This was introduced in the Emotional Modal Agency.

- *Self-study assignment:*
  The concept was to encourage the participants to individually find more resources for the theoretical concepts. The preparative assignment required that each participant had to self-study and complete an assignment before class. This was also introduced in the Emotional Modal Agency.

- *The theoretical content course material:*
  The course material was adjusted in the following way: align the images and examples in the notes with the direct context where the intervention will be implemented; include abstract visual representations; include a list of additional resources for self-study, and leave space for note-taking and drawing.

- *Group-work process model:*
  Group size and activities influenced the way in which the participants participated and understood the theoretical concepts. To address the shortfalls of traditional group-work, the following process was developed and implemented during group-work activities:

Step 1: (4-6 participants: large groups) Explaining, discussing or making sense of the theoretical concept (helping with the transfer between the notes (mediate object) to the mental representation.

Step 2: (2 participants: small groups) Combining or presenting each other's ideas (from the immediate to the sign).

Step 3: (2 participants) Discussing how to implement (re-contextualise the sign into an abstract symbol).

Step 4: (2 participants) Creating the artefact; and

Step 5: (4-6 participants) Presenting and reflecting on the understanding and linking back to the theoretical concept

Stage 1 of the intervention started a week earlier with a preparative assignment that was handed out to the participants. The concept of the 'study-buddy' was also introduced and the participants selected their 'study-buddy' and exchanged contact details. A week after that, the intervention continued within the traditional studio classroom context, but after the introduction of the theoretical concept, the context changed to a more domain specific, authentic contextual environment. The rest of the intervention was implemented outdoors.

7.6.1 Basic Design Principle: Movement and rhythm

The way the artist leads the eye in, around and through a composition, is the path the eye follows. Motion or movement in a visual image occurs when objects seem to be moving in a visual image. Movement in a visual image comes from the kinds of shapes, forms, lines and curves that are used. Movement also contributes to the overall unity in a design by creating a relationship between the various components of layout or design. There are various ways to create this relationship, and one of the ways are using repetition and rhythm (Bernard, 2012). The lesson focused on the following principles of repetition and rhythm, dividing them up into the following concepts:

- Concept 1: Regular rhythms

  Regular repetition occurs when the intervals between elements are predictable, or the elements themselves are similar in size and length. Placing repeating elements at regular intervals would be an example.

- Concept 2: Alternating rhythms

  A repetition that changes in a pattern, a deliberate placement of elements to create opposition by abrupt transition rather than gradual.

- Concept 3: Progressive rhythms

  Progression occurs when there is a gradual increase or decrease in the size, number, colour, or some other quality of the elements repeated.

Table 7.30 : Iterative cycle 3 modal agency intervention – Stage 1

Theoretical Concept	DKSP Steps	Modal Agency and Semiotic Tools	Activity
Preparatory assignment - natural rhythms - one week in advance	1	Emotional Modal Agency: - Self-Study	Each participant received a reader on natural rhythms with an assignment that they had to submit the following week. (Addendum I)
Introduction - movement and rhythm - in class	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally introduced the theoretical concept in class and explained the link between the theoretical concepts and the context.
	1	Ideational Modal Agency: - the theoretical content course material	Each participant received the theoretical content course material.
Concept 1: Regular rhythms (Outdoors)	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally explained the concept of regular rhythms.
	2	Ideational Modal Agency: - Verbal Presentation Sensory Modal Agency: - Kinesthetic Expression Emotional Modal Agency: - Group-work (introduce new group-work process model)	The participants were divided into large groups that discussed the following: what rhythm means to them, and rhythm in traditional music. They had to select some traditional rhythms and show it to the rest of the class.
	2	Ideational Modal Agency: - Verbal Presentation - Direct Presentation Sensory Modal Agency: - Kinesthetic Expression Emotional Modal Agency: - Group-work (small groups)	Each 'study-buddy' group was requested to discuss regular rhythm and create a regular rhythm music pattern with their hands (Figure 7.53).
	2	Ideational Modal Agency: - Direct Presentation - Theoretical content course material Logical Modal Agency: - Logical Iconic Presentation	The lecturer and all the participants walked outside, next to a building with lots of windows; they had to identify and draw elements with regular intervals.
	3	Ideational Modal Agency: - Indirect Representation Sensory Modal Agency: - Natural Iconic - Kinesthetic Expression Emotional Modal Agency: - Group-work	Each large group had to identify a regular rhythm example in nature. They had to identify the rhythm in the example and create a group pose representing that rhythm (Figure 7.54).
	4	Ideational Modal Agency: - Indirect Representation Sensory Modal Agency:	The 'study-buddy' groups had to create and draw, on paving, a 1 x 1 meter abstract symbol of that rhythm. Each participant

		- Kinesthetic Drawing Emotional Modal Agency: - Group-work Logical Modal Agency: - Logical Symbolic Representation	had to redraw their abstract symbol in their theoretical content course material
<u>Concept 2:</u> Alternating rhythms (Outdoors)	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally explained the concept of alternating rhythms.
	2	Ideational Modal Agency: - Verbal Presentation - Direct Presentation Sensory Modal Agency: - Natural Iconic - Kinesthetic Expression Emotional Modal Agency: - Group-work	Each large group: - discussed the concept of alternating rhythm; - differentiated between regular and alternating rhythm, and - created a musical rhythm and expressed that rhythm through the movement of their bodies (no clapping of hands).
	2 and 3	Ideational Modal Agency: - Direct Presentation - Indirect Representation Logical Modal Agency: - Logical Symbolic Representation	Each participant had to individually: - study a paving pattern and identify repetition that changed in pattern or contrast; - draw that pattern in their notes, and - redraw a representation of that pattern, using only lines (Figure 7.55).
<u>Concept 3:</u> Progressive rhythms (Outdoors)	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally explained the concept of progressive rhythms.
	2 and 3	Ideational Modal Agency: - Verbal Presentation - Direct Presentation Sensory Modal Agency: - Natural Iconic - Kinesthetic Expression Emotional Modal Agency: - Group-work	Each large group: - discussed the concept of progressive rhythm; - differentiated between regular, alternating and progressive rhythm, and - created a pose with all the group members that represented progressive rhythm.
	2 and 3	Ideational Modal Agency: - Direct Presentation - Indirect Representation Sensory Modal Agency: - Natural Iconic Emotional Modal Agency: - Group-work Logical Modal Agency: - Logical Iconic Presentation - Logical Symbolic Representation	The 'study-buddy' groups had to: - identify in nature an example of the concept; - draw a direct presentation of that element in their notes, and - create a composition using other plant materials to represent that example.
	4	Logical Modal Principle: - Logical Symbolic Representation Emotional Modal Principle: - Group-work Sensory Modal Principle: - Kinesthetic Drawing	Each large group: - discussed and planned how to design a walkway paving pattern that used progressive rhythm to indicate direction and movement; - drew the paving pattern with chalk on the ground, 1 x 2 meters long (Figure 7.56).

Figure 7.53: Study-buddy exercise indicating rhythm.
Source: Author

Figure 7.54: Group activity illustrating a regular rhythm example in nature and a group pose representing regular rhythm.
Source: Author

Figure 7.55: Individual drawing illustrating rhythm.
Source: Author

Figure 7.56: Group drawing illustrating rhythm indicating direction.
Source: Author

7.6.2 Qualitative analysis of Design Assignment 4 (Stage 2)

The outcomes of the design assignment 4 were evaluated on an achievement scale between 1 and 5 (see design assessment rubric in Addendum F). Two independent assessors evaluated the design assignments objectively and the agreement between assessors was analysed for each task. The Cronbach Alpha tests of inter-observer reliability for different combinations of two assessors indicated an excellent reliability of 0.92 between the two assessors on each task.

A detailed table of the results obtained by the participants in design assignment 4 is presented in Addendum H. The scores were standardised (Table 7.31); taken together, the average percentage scores for the participants ranged between 2.5 (the design idea/solution did satisfy the design requirements) and 3.5 (the design idea/solution did satisfy the design requirements). The mean score was 3 (one or both compositions indicated rhythm, but there was either no difference in the methods used, wrong, or no indication of the methods used; the design idea/solution did satisfy the design requirements). The bar chart for the average percentage scores of each participant is shown in Figure 7.57. The mean score of 3 (score level of 60%) indicated that halve of the participants scored 60% and above, with the highest number of participants (15) in the score frequency interval between 3.0 and 3.4. (Figure 7.58). The minimum score of 2.5 (score level of 50%), two participants, highlighted that all the participants were able to indicate movement through rhythm, but still struggled to completely satisfy the whole assignment.
The comments from the assessors predominantly referred to the inability to label the method used, highlighting a weak cognitive link between the theoretical concept and the verbal identification of interpretational artefact:

> *everyone could illustrate at least one rhythm correctly but those who did illustrate two correctly did not label them* (assessor 1)
>
> *There are identifiable rhythmic patterns - very creative, but no labels* (assessor 2).

Table 7.31: Descriptive statistics for Design Assignment 4

Design Assignment 4: aggregate scores	
Mean	2.97
Standard Deviation	0.21
Minimum	2.5
Maximum	3.5

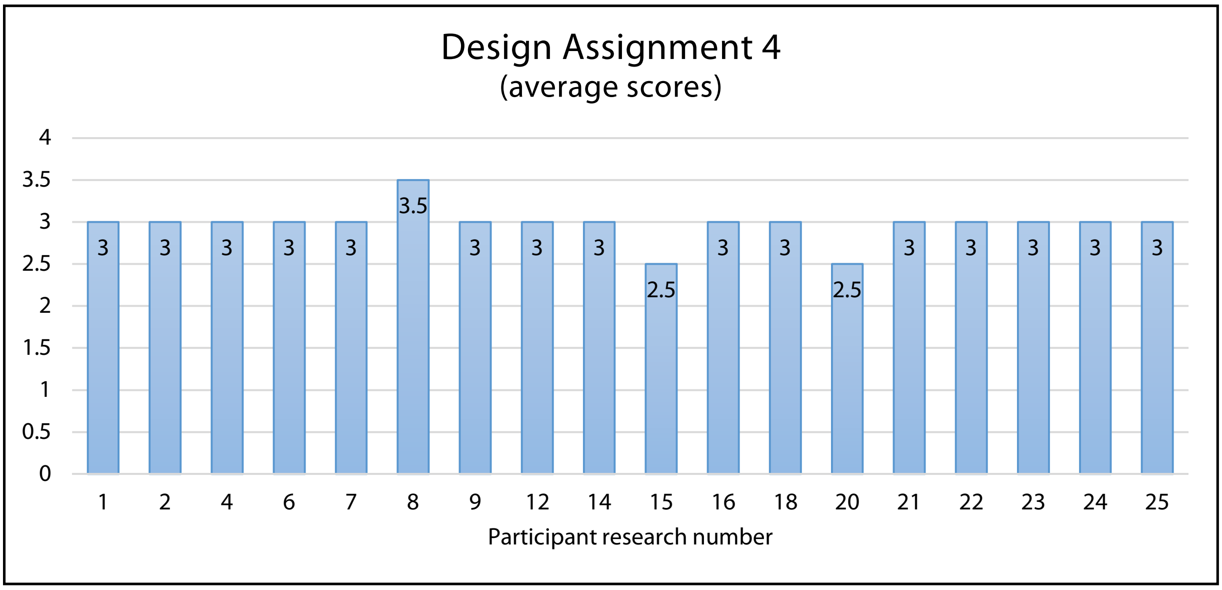


Figure 7.57: Average scores of Design Assignment 4 for each participant (Cycle 3)

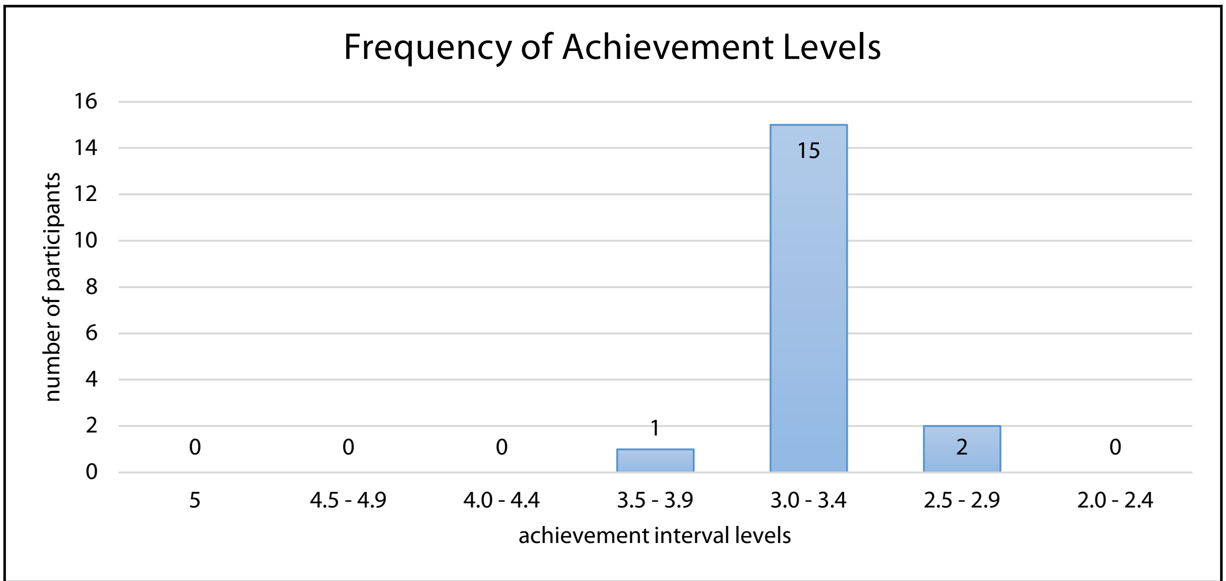


Figure 7.58: Frequency of achievement levels in Design Assignment 4 (Cycle 2)

7.6.3 Quantitative analysis of the Modal Agencies Intervention (Stage 1)

The Modal Intervention consisted of the following agencies:

- Ideational Modal Agency
- Sensory Modal Agency
- Logical Modal Agency
- Emotional Modal Agency.

Figure 7.59 indicated the percentage of quotes that relates to each participant's perspective on the influence each agency had on his/her semiotic transference process.

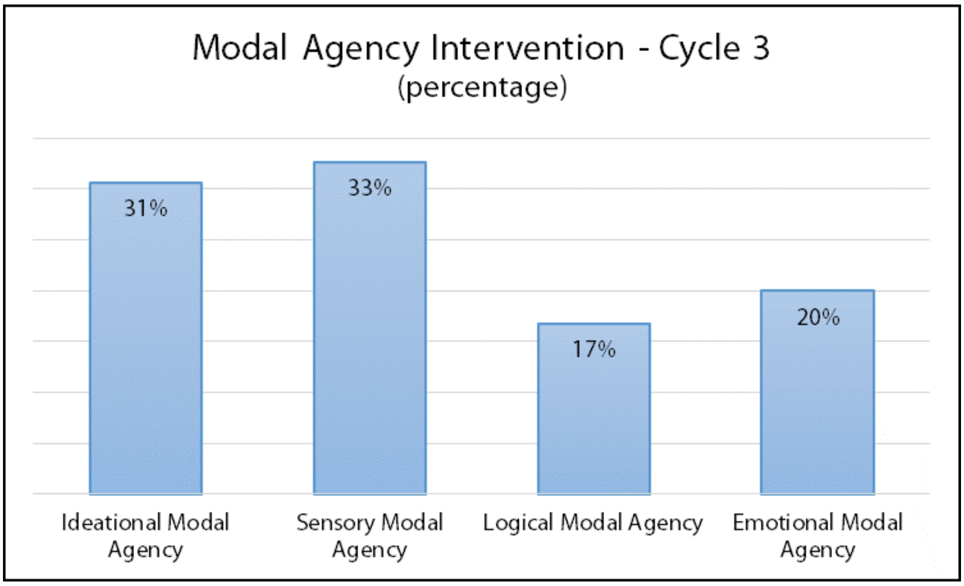


Figure 7.59: Modal Agency Intervention Perspective Analysis (Cycle 3)

7.6.3.1. Ideational Modal Agency

The Ideational Modal Agency consisted of the following semiotic tools:

- Theoretical content course material
- Verbal presentation
- Direct presentation
- Indirect representation.

Figure 7.60 indicated the percentage of quotes that relate to each participant's perspective on the influence each modal agency had on his/her semiotic transference process.

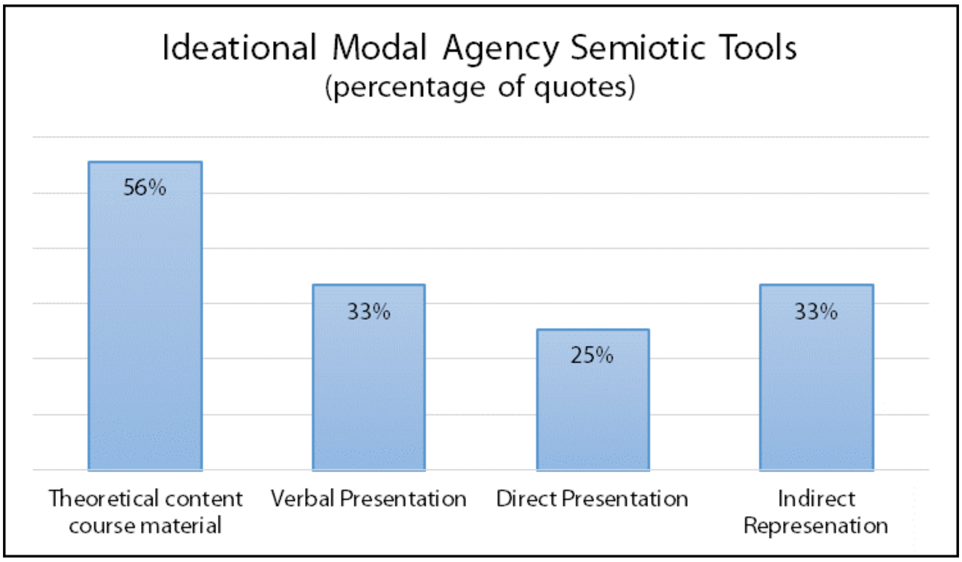


Figure 7.60: Ideational Modal Agency Semiotic Tools Perspective Analysis (Cycle 3)

a) *Theoretical content course material*

The influence of the theoretical content course material (notes) semiotic tool on the semiotic contextualisation process was classified as either contributive or non-contributive (Table 7.32).

Table 7.32: Contribution of the theoretical content course material semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	Supported the creation of visual and verbal links between the theoretical concept and the sign (icon or symbol).	*****	*the notes helped me a lot. They were able to illustrate to me the information* (16)
	Provided a theoretical resource that facilitated the interpretation process beyond the classroom context.	****	*Last week, I did not attend so my study partner got me the notes and then I had to still study the notes* (7)
	The notes sustained semiotic transference by becoming a reflective and prompting resource, assisting the recollection of the theoretical concepts.	***	*that I could remember, oh in the notes that I went through there was this and then – that's why I understood that sometimes reading it goes with time. It's because I remember that oh they were talking about the rhythm* [theoretical concept] *yeah, everything* (group interview)
Contributive: Iterative cycle 3	The affordance of various context specific and abstract visual representamen in the notes supported semiotic transference.	***	*The notes that Mr Griesel gave us, it explain everything in detail, and it had graphics* [representamen] *that shows different types of rhythms* (20) *so it became more visible. It was visible and you could understand this is the type of rhythm* (group interview)
	The additional spaces for note taking and drawing encouraged interaction with the semiotic transference process.	***	*Yeah, it did help us because now we are able to interact with our notes. We feel like we did something, we belong. Unlike before, we were just given, given something, you don't have that courage to just go through. But now we can interact* (group interview)
	The physical action of drawing signs in the notes supported the visual recollection process of the theoretical concepts.	*****	*There was a lot of difference because with these notes, the latest, we had spaces to draw like everything on what we witnessed, the nature, what we see. So that helped us a lot because when you just go through your notes you will remember, oh, I saw this when I was passing through the space and then you at least relate to what you have seen* (group interview) *the notes did help us a lot we could relate to it* (group interview)
Non-contributive[69]: Recurring from iterative cycles 1 and 2.	The English language and reading skills barrier, that some of the participants at CPUT faced, caused reading and understanding the notes to be problematic.	************	*The notes didn't help me that much because I couldn't understand them* (9) *We had to read through the thing of the rhythm but I couldn't understand a single word on the page. I was like I don't know the words* (group interview)
	Resistance to reading due to a perception that notes are only there for assessment and not for understanding.		

[69] There were no additional non-contributive contributions from iterative cycle 3.

	Reading alone did not create a strong semiotic link between the theoretical concept and the sign, which led to participants struggling to remember that link.	**	*So to show it on paper, something that you can see was kind of hard for me because I didn't quite get a good understanding* (4)
	The visual link between the written text and the images in the notes were not emphasised enough.		
	A perception among some participants that, if they understood the theoretical concept, further reading and studying that was unnecessary.		

This semiotic tool had the highest contribution (56%) (Figure 7.60) to the perceived effect that the Ideational Modal Agency had on the participants; 24 of the 38 quotes (63%) indicated that this tool contributed to their semiotic transference process (Figure 7.61).

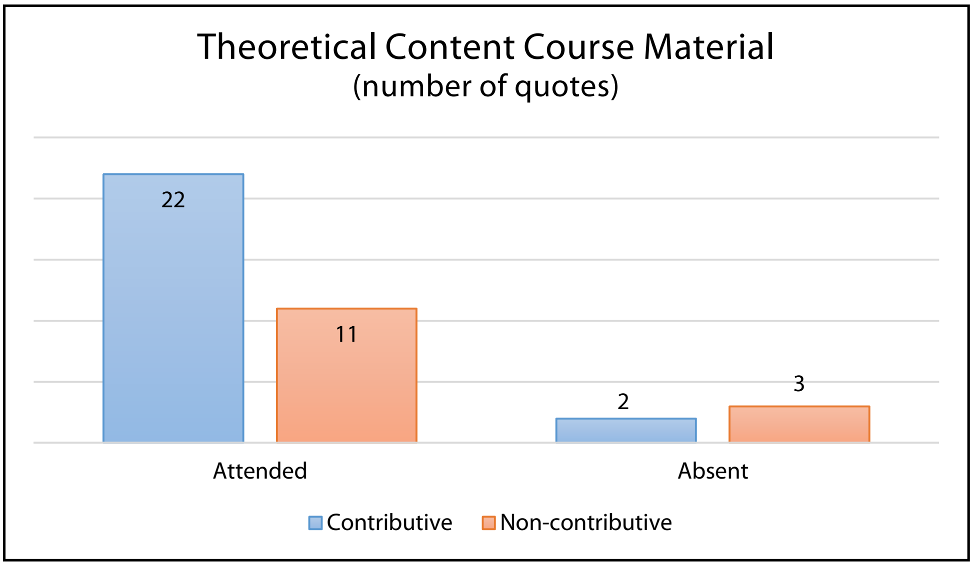


Figure 7.61: Contribution of the theoretical content course material semiotic tool (Cycle 3)

The theoretical content course material semiotic tool contribution to the semiotic transference process was restricted to the physical barriers, language and reading skills that the participants experienced. The success of this tool relies on its integration with the other three main modal agencies. The semiotic process can be further enhanced by: introducing more context specific and interactive visual resources, encouraging extended individual learning and research activities and by addressing the reading challenges the participants faced.

b) Verbal presentation

The influence of the verbal presentation semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.33).

Table 7.33: Contribution of the verbal presentation semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	Facilitated the semiotic transference process between the theoretical concept and the sign by the introduction of visual and practical activities and examples during the verbal presentation.	******	*it helped a lot because he* [the lecturer] *knows what he's talking about. He also showed us the examples* (16)
	Verbally facilitated the semiotic transference process between the theoretical concept (notes) and the sign, reducing the physical barriers, language and reading skills.	*******	*he* [the lecturer] *was reading the notes and then explaining to us further on how rhythm is and how it works* (20) *Even the notes, as he* [the lecturer] *was busy explaining the notes, it helped me to understand the concept about rhythm well and understand it* (24)
	Encouraged active participation in their own learning process.	***	*about the meaning of the reading and showed me pictures and then the notes that the lecturer gave us helped me to understand the types of rhythms and then I'll search on the internet the types and pictures of rhythm* (17)
Contributive: Iterative cycle 3	The intervention sustained semiotic transference by becoming a reflective and prompting resource, assisting the recollection of the theoretical concepts.	****	*I remember the way the things that were said to us last week by the lecturer. It helped me remember that he explained to us that on rhythm you can make something small, then big, small, big, small* (25)
Non-contributive: Recurring from iterative cycle 1 and 2.	The semiotic transference through verbal presentation required that the participant had to be physically present.		
	The language barriers were intensified by the verbal intervention.	*********	*The lecturer, he tried to explain more about rhythm. I had no idea of what he was talking about* (9)

The verbal presentation semiotic tool had the highest contribution (33%) (Figure 7.60) to the perceived effect that the Ideational Modal Agency had on the participants; 13 of the 21 participating participants indicated that this tool contributed to their semiotic transference process (Figure 7.62). However, there was a need to be verbally introduced to the theoretical concept:

> *The only thing that I think must be changed, like to explain to us everything before we even come into the lesson* (15)
>
> *Mr Griesel* [the lecturer] *must first explain before we do something* (12).

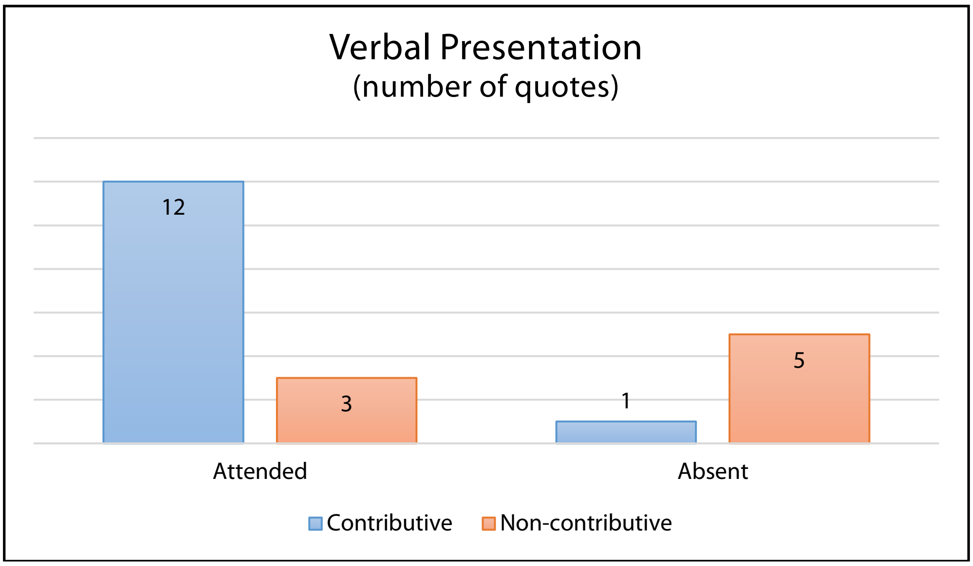


Figure 7.62: Contribution of the verbal presentation semiotic tool (Cycle 3)

The verbal presentation semiotic tool contributed to the semiotic transference process by supporting the establishment of a verbal link between the theoretical concept and the sign. The semiotic process can be further enhanced by: encouraging the participants to verbally engage with their own learning process and by directing the learning process towards a collaborative knowledge transfer process. The collaborative knowledge transfer process will mediate the verbal and language challenges the participants experienced.

c) *Direct presentation*

The influence of the direct presentation semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.34).

Table 7.34: Contribution of the direct presentation semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	The practical/physical implementation of step 2 in the modal agency meaning making process (Figure 6.3) facilitated the conceptualisation process between the theoretical concept and a context specific icon, and created a resource of context specific information.	******	*The nature, the nature helped, the flowers* [context specific icon] *because we learnt in the class that there were alternating rhythm* [theoretical concept] *and there was a direct, that the rhythm was giving the direction. So because of outside where we were doing all this, there are plants and the plants are put in the direction and in rhythm so that also helped* (16)
	The outdoor natural environment provided authentic context specific visual resources to become the representamen for the contextualisation process, grounding the contextualisation process firmly into a domain specific context (Table.4.2).	*****	*We had to look for examples of rhythms in nature and we saw trees and cars outside. So at least we had an idea of how our rhythm is* (20)
	The domain specific environment becomes the primary reflective resource, both for the student and the lecturer, explicitly linking the natural environment to the domain of Landscape Architecture	****	*when the lecturer is explaining something, he would refer to the nature and then that made me understand about rhythm* (9) *It's like the landscape is outside* (group interview)

Contributive: Iterative cycle 3.	The outdoor natural environment, previously seen in iterative cycle 2 as an irrelevant teaching and learning environment, became an important platform to understand the theoretical concepts.	***	*And the example in nature, there are lots of examples that are also going to help me. Like one thing is the progressive rhythm in nature that helps me understand and see* (23)
Non-contributive: Recurring from iterative cycle 1 and 2.	Unable to comprehend the relevancy of nature (specific context) in the learning process.	*	*the examples in nature, I saw some examples but they did not help me a lot* (17)
	Nature as a teaching and learning environment created a sense of confusion and not knowing what to expect.	*	*We could not understand that we were supposed to do on when we were first given the work* (group interview)
	Moving from a traditional classroom environment, which is safe and private, to an outdoor natural environment, exposed to natural elements and social interaction, created a sense of social exposure.		
	The outdoor natural learning environment also challenged them physically and exposed them to natural elements.		
Non-contributive: Iterative cycle 3	The visual link between the theoretical concept and the context specific icon was not strong enough to facilitate complete recollection of the theoretical concept.	**	*I remember there were trees that were showing some rhythm. So then I remembered those that showed – it helped me a little bit* (25)

The analysis of quotes relating to the contribution of the direct presentation semiotic tool, Figure 7.60, indicated a 22% contribution to the semiotic contextualisation process, and 18 of the 22 quotes indicated a positive contribution, mostly by the attending participants (Figure 7.63).

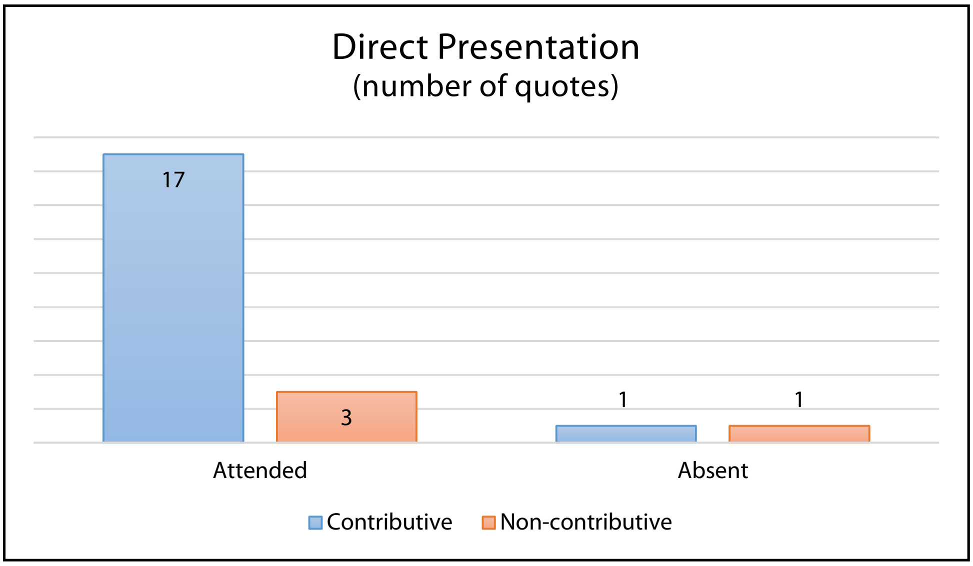


Figure 7.63: Contribution of the direct presentation semiotic tool (Cycle 3)

The direct presentation semiotic tool contributed to the semiotic transference process by supporting the semiotic contextualisation of the theoretical concept into a domain specific[70] icon, grounding the contextualisation process firmly into a domain specific context. The

[70] Landscape Architecture.

semiotic contextualisation process can be further enhanced by: being aware that some participants cannot relate to the natural environment as a teaching and learning resource, by incorporating the other modal agencies to facilitate this step[71] in the semiotic transference process, and by explaining why the context, the natural environment, is important to the Landscape Architecture domain.

d) Indirect representation

The influence of the indirect representation semiotic tool on the semiotic de-contextualisation process was classified as either contributive or non-contributive (Table 7.35).

Table 7.35: Contribution of the indirect representation semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	Created both visual and cognitive links between the theoretical concept and a direct abstract symbol.	****	*And then there were drawings that were drawn. So the drawings helped me a lot because the drawings showed the different shapes and different structures but with different rhythms and then the examples in nature* (17)
	Semiotic transference between the theoretical concept and the immediate[72] object (Figure 6.2) was effective enough so that the participants could remember the direct symbol and de-contextualise it into an abstract symbol.	***	*This one reminded me of the paving that's around campus* [direct symbol]. *When I saw the picture, immediately that paving pattern just came to my mind just like that* (24)
	Semiotic transference was enhanced through the co-implementation of the other interventions, indicating the positive contribution the intervention had on the interpretation process.	**	*I started remembering so when we were given this task so I remembered what we did the past week and I remembered the poses we did, the drawings, the examples, the nature, the small group and the big group-work. And that made able to know what to do* (9)
Contributive: Iterative cycle 3.	Encouraged the participants to reflect on their own semiotic transference processes, highlighted the importance of the participants' self-perceptions of their own creative competency.	*	*Yes, because when you draw something your mind is a picture and it's imprinted into your mind so we won't forget it. It's like you drew it and you have it installed in your mind* (group interview)
	Stimulated creative expression and self-confidence.	**	*Well today, was actually really better because there we actually used our own ideas to make rhythm* (21)
	Inspired creative exploration by making them aware that they can de-contextualise a context specific icon and identify, on their own, an indirect representation of that theoretical concept, even extending that into other contexts.	**	*When I saw the paving, immediately that paving pattern just came to my mind just like that* (24) *It helps us a lot because now with rhythms from the nature that were there, you could see the rhythms not limited into the landscape only. It is there in clothing and stuff like that. Now we are able, like we can see, we can spot it wherever it is* (group interview)

[71] Step 2 of the modal agency meaning making process.
[72] The transferred mental representation of the object/theoretical concept.

Non-contributive[73]: Recurring from iterative cycles 1 and 2.	Underdeveloped ability to create a visual and cognitive link between the theoretical concept and an abstract symbol and then de-contextualise it into an abstract indirect representation.	**	*I can say that and the trees, ja like the movement of the trees in parking lot helped* [context specific icon]. *And ja and the paving* [indirect representation] *it didn't really help a lot because there was, how can I say… could not understand that's why* (21)
	Struggled to comprehend the relevancy of nature (specific context) in the learning process.		

The indirect representation semiotic tool only contributed 14% (Figure 7.60) to the perceived effect that the Ideational Modal Agency had on the participants, but almost all (88%) the participants indicated that this tool did contribute to their semiotic transference process (Figure 7.64).

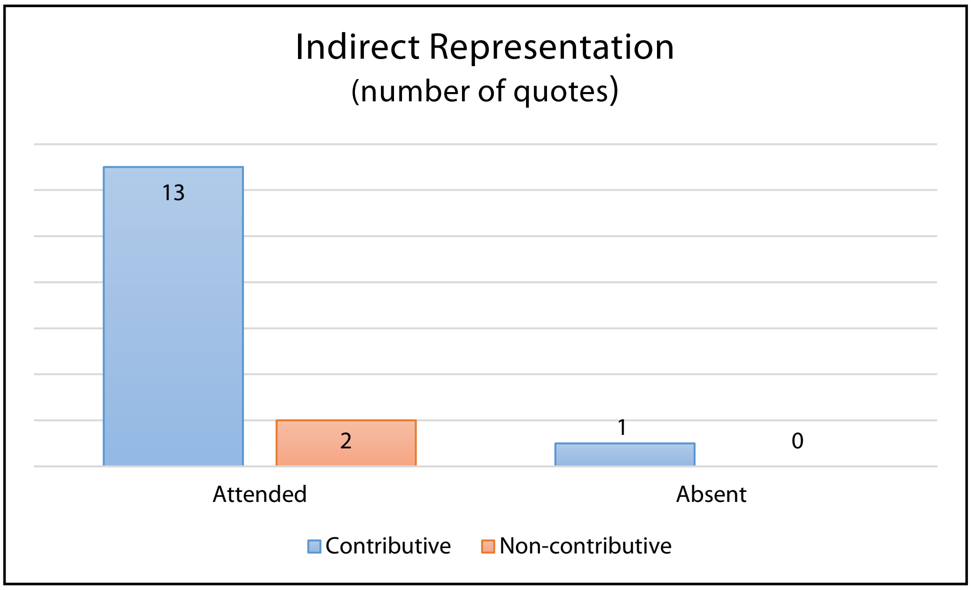


Figure 7.64: Contribution of the indirect representation semiotic tool (Cycle 3)

The indirect representation semiotic tool contributed to the semiotic transference process by supporting the semiotic de-contextualisation of the direct symbol into an abstract symbol[74]. The semiotic contextualisation process can be further enhanced by: incorporating the other modal agencies as the facilitating agents in the semiotic de-contextualisation process and by creating more physical interpretation activities between the symbol and an abstract artefact – indirect representation.

7.6.3.2. Sensory Modal Agency

The Sensory Modal Agency consisted of the following semiotic tools:

- Natural iconic presentation
- Kinesthetic drawing
- Kinesthetic expression

[73] There were no additional non-contributive contributions from iterative cycle 3.

[74] Step 4 of the modal agency meaning making process.

Figure 7.65 indicated the percentage of quotes that relates to each participant's perspective on the influence each semiotic tool had on his/her semiotic transference process.

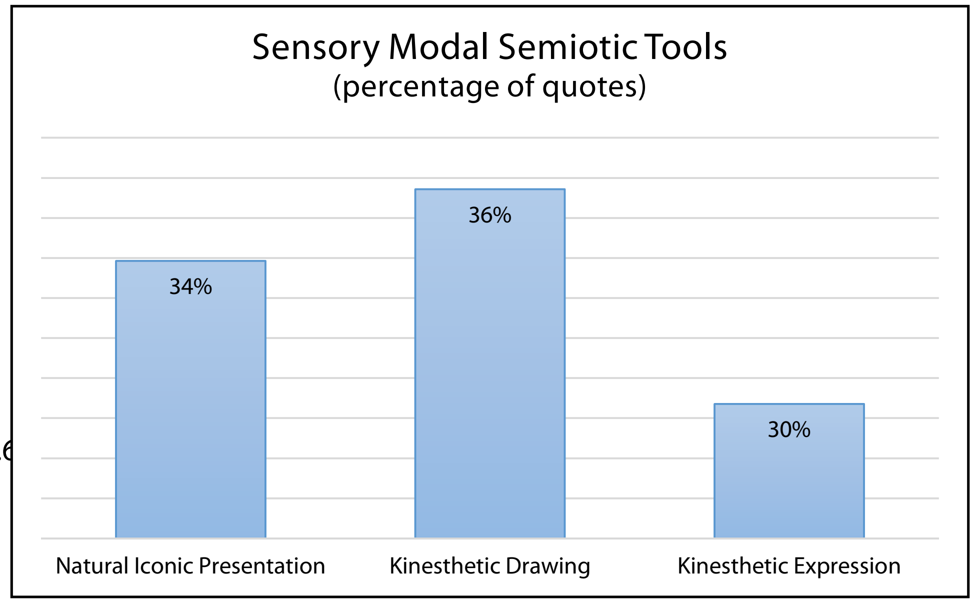


Figure 7.6

a) Natural iconic presentation

The influence of the natural iconic presentation semiotic tool on the semiotic transference process was classified as either contributive or non-contributive, however there was only contributive quotes for this tool (Table 7.36).

Table 7.36: Contribution of the natural iconic presentation semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	The outdoor natural environment provided authentic context specific visual resources to become the natural iconic[75] examples for the contextualisation process, grounding the contextualisation process firmly into a domain specific context (Table 4.2).	**** ***	*And then the example in nature, they did help a lot, the flowers* [natural iconic example] *that we have seen, they showed rhythm and it was easy for me to understand what rhythm really is* (14)
	Encouraged the use of the natural environment as a resource of inspiration.	**	*there was also a picture with the paving which also made me remember that we did something yesterday in connection with the paving* (1)
	The natural environment was used as symbol that represented the emotional challenges some of the participants faced during the design process.		
	The intervention assisted in the recollection process and created	***	*Another thing that helped me was examples in the nature so we took the rhythm and then we tried to find*

[75] Iconic refers to the resemblance or imitation of the object (theoretical concept) by looking exactly like it (i.e. photograph) in nature.

	external visual prompts to the theoretical concepts.		*something that we can see in nature that represents the particular rhythm that we chose* (1)
Contributive: Iterative cycle 3.	The physical and natural environment is a domain specific platform that affords identifiable, both for the lecturer and student, and shares exemplars for theoretical representamen.	****	*The nature, the nature helped the flowers because we learnt in the class that there were alternating rhythm and there was a direct, that the rhythm was giving the direction. So because of outside where we were doing all this so that also helped* (16)
	The outdoor natural environment, previously seen in iterative cycle 2 as an irrelevant teaching and learning environment, became an important platform to understand the theoretical concepts and support the semiotic contextualisation process.	***	*For me, I would like if the intervention classes would be outside like on daily basis because it's easier outside than in class because, we could see rhythm in nature and here in class it's difficult to just understand, so yeah…when we're outside I think we are experiencing a lot from nature, because I remember when you said we must look for a rhythm in nature. We used trees and other stuff. So if we were in class we wouldn't be able to relate trees with rhythm* (group interview)
Non-contributive[76]: Recurring from iterative cycles 1 and 2.	Nature was seen as not a valid resource of information.		

The natural iconic presentation semiotic tool contributed 34% (Figure 7.65) to the perceived effect that the Sensory Modal Agency had on the participants; all the participants indicated that this tool contributed to their semiotic transference process (Figure 7.66):

> *And then the example in nature, they did help a lot, the flowers that we have seen, they showed rhythm and it was easy for me to understand what rhythm really is* (14).

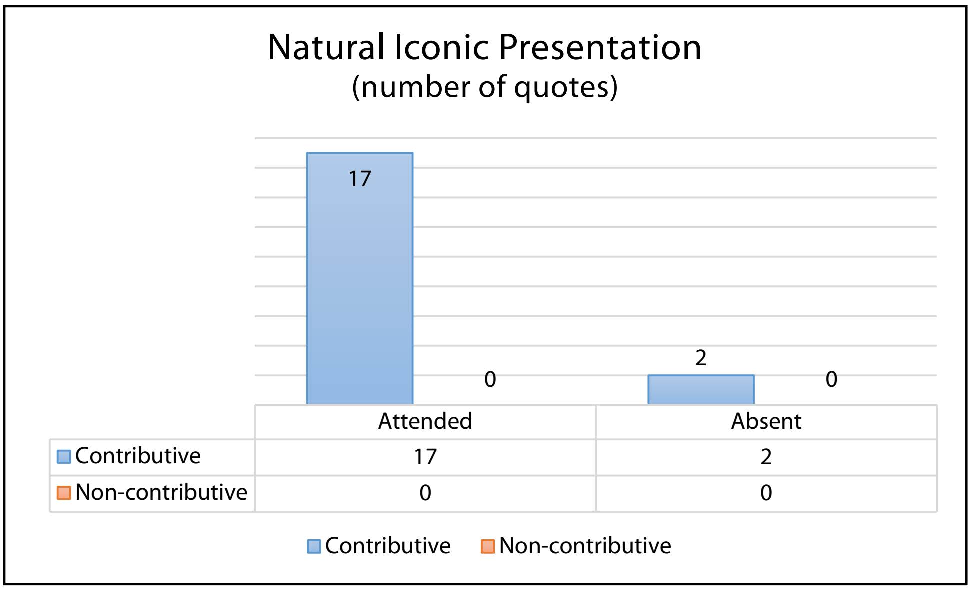


Figure 7.66: Contribution of the natural iconic presentation semiotic tool (Cycle 3)

[76] There were no non-contributive contributions from iterative cycle 3.

The natural iconic presentation semiotic tool contributed to the semiotic transference process by providing a practical context specific platform for physical and natural resources in the creation of natural iconic examples.

b) Kinesthetic drawing

The influence of the kinesthetic drawing semiotic tool, as applied in conjunction with the indirect representation semiotic tool on the semiotic de-contextualisation process, was classified as either contributive or non-contributive (Table 7.37).

Table 7.37: Contribution of the kinesthetic drawing semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	Created physical and context specific visual links between the theoretical concept and sign.	******	*It was the drawings*[77]*. The drawings helped me a lot because they showed me how to use different shapes and how to use different structures to do rhythm* (17)
	Created the environment where the participants were encouraged to actively participate in the interpretation process.	***	*how can I say, you feel with your eyes and you try to do something better with what you have* (21)
	Facilitated collaborative learning activities through the interaction between their physical bodies, conceptual environment and physical/natural environment.	****	*Then the drawings we did outside also helped me so it was more active. So I can use my hands more and see how things are done* (23)
	Created the environment that supported development of self-perceptions regarding creative competency.	***	*Now we are able, like we can see, we can spot it wherever it is* (group interview)
Contributive: Iterative cycle 3.	The practical implementation of the semiotic transference process, during this intervention, created opportunities for the participant to reflect, assess and correct their interpretation of a theoretical concept.	**	*The drawings that we drew as a group and as individuals also helped because if you drew something that is incorrect the lecturer will then tell you this is wrong, you have to redo it again. So it helped* (16)
Non-contributive[78]: Iterative cycle 3.	Struggled to comprehend the relevancy of drawing activities in the learning process.	**	*we could not understand why we even do the drawings that we were supposed to do* (group interview)

[77] The word "drawing" refers to kinesthetic activity, the physical process of drawing using the whole body to draw and not the Icon and Direct symbol.
[78] There were no non-contributive contributions from iterative cycles 1 and 2.

The kinesthetic drawing semiotic tool contributed 36% (Figure 7.65) to the perceived effect that the Sensory Modal Agency had on the participants; 18 of the 20 quotes indicated that this tool contributed to their semiotic transference process (Figure 7.67).

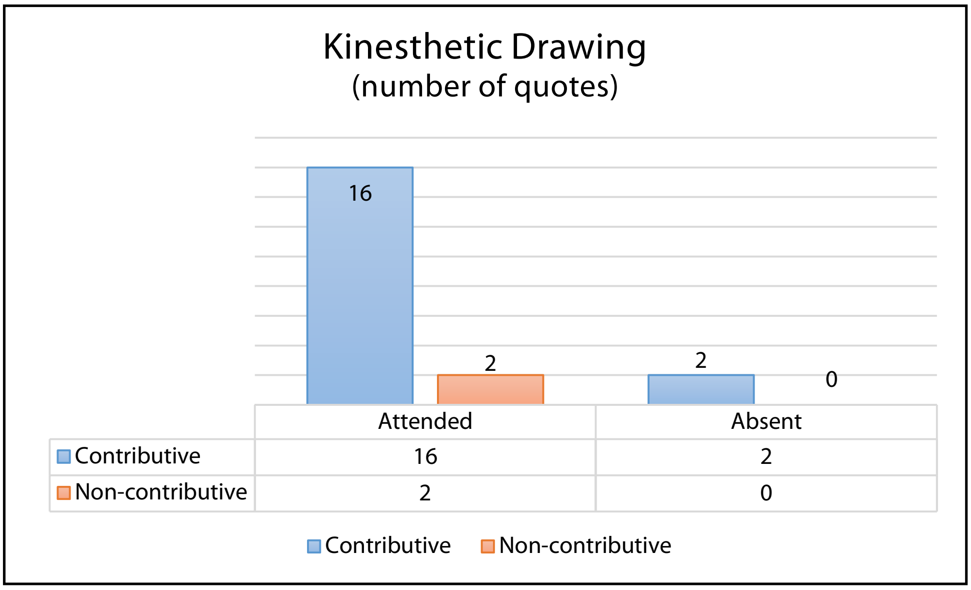


Figure 7.67: Contribution of the kinesthetic drawing semiotic tool (Cycle 3)

The kinesthetic drawing semiotic tool facilitated the semiotic de-contextualisation process through the creation of physical and practical visual links, encouraged active participation in the interpretation process and facilitated learning through the interaction between their physical bodies, conceptual environment and physical/natural environment. The semiotic re-contextualisation process can be further enhanced by: aligning each drawing assignment to specific theoretical concepts, and by encouraging all the participants to individually engage with each drawing assignment.

c) Kinesthetic expression

The influence of the kinesthetic expression semiotic tool on the semiotic de-contextualisation process, as applied in conjunction with both the indirect representation (7.6.3.1.d) and the emotional group-work (7.6.3.4.a) semiotic tools, was classified as either contributive or non-contributive (Table 7.38).

Table 7.38: Contribution of the kinesthetic expression semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	The physical/kinesthetic implementation of steps 4 and 5 in the Design Knowledge Semiotic Process (Figure 6.2) facilitated the de-conceptualisation process from the Direct Symbol to the Abstract Symbol and Interpretation.	***	*So I realised that this class must go outside and doing the practical work, being able to see everything. It helps us a lot because now with rhythms from the pictures that were there, you could see the* [direct symbol] *rhythms not limited into the landscape only. It is there in clothing and stuff like that* [abstract symbol]. *Now we*

			are able, like we can see, we can spot it wherever it is (18)
	The physical/kinesthetic implementation of steps 4 and 5 in the Design Knowledge Semiotic Process supported the recollection of theoretical concepts by referring back to the physical activities.	****	*So these are the resources that helped me with this assignment that we had today. So the one that helped me the most were the physical activities that we did yesterday* (1)
	Encouraged active participation in the interpretation process and enhanced their understanding of the theoretical concepts.	***	*Being outside was fun because when we were outside we're interacting with the lecturer than we're working in class because when we are in class we are just sitting and listening to what the lecturer is saying. But when we are outside we are practically doing what the lecturer is saying* (group interview)
	Created a safe supportive environment for creative expression and experimentation.	**	*The most thing that helps me is the way that we do the poses in group like, I could <u>ask someone to explain it more</u>, I don't understand and yeah like <u>when we have finished something then we draw it by ourselves. So that helps me</u>* (group interview)
	Enhanced an individual's self-efficacy and creative self-confidence to be more willing to participate.		
	The co-implementation of the other interventions not only facilitated the semiotic transference process, but also strengthened some of the weaker semiotic links created by other interventions.	**	*And what helped me a lot, the physical activities because you could understand – we <u>would say things</u>* [Verbal]. *We would say things and <u>do them</u> like the physical activities and <u>examples in nature</u> about the regular rhythms* (24)
Contributive: Iterative cycle 3.	Encouraged the whole class to participate and be actively involved in the teaching and learning activities.	**	*Okay, the one that helped me most is yesterday's one because we were doing like, <u>everyone was active</u>. Like everyone was working with the lecturer* (21).
Non-contributive: recurring from iterative cycles 1 and 2	Resistance to physical activities		
	The perception that physical activities could be seen as playing.		
Non-contributive: Iterative cycle 3.	Struggled to comprehend the relevancy of physical activities in the learning process.	*	*That's why it's also small* [79], *because it did not helped that much, the poses* [physical activity] (8)

The kinesthetic expression semiotic tool contributed 30% (Figure 7.65) to the perceived effect that the Sensory Modal Agency had on the participants; 16 of the 17 quotes (94%) indicated that this tool did contribute to their semiotic transference process (Figure 7.68).

[79] Referring to the circle sizes of the Venn diagram, i.e. small circles represented a low contribution.

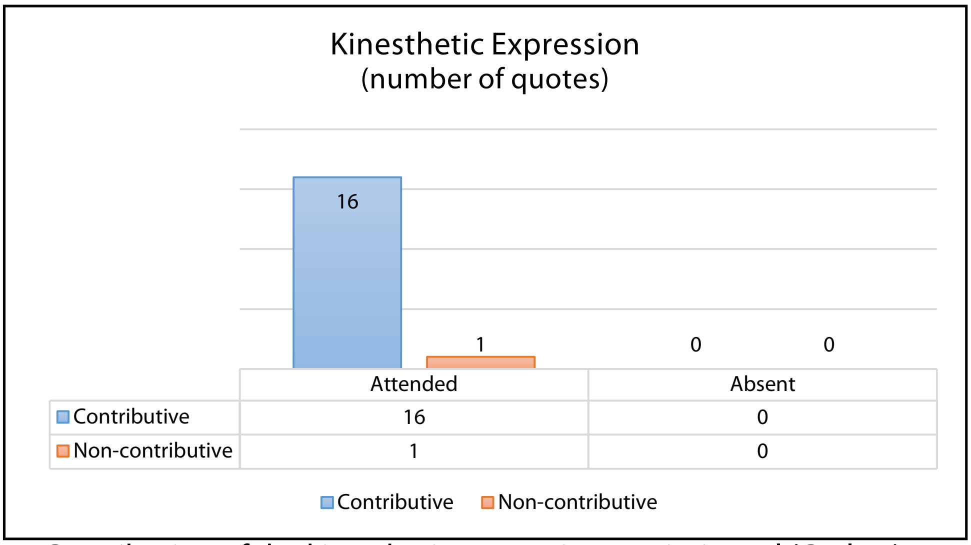


Figure 7.68: Contribution of the kinesthetic expression semiotic tool (Cycle 3)

The kinesthetic expression semiotic tool facilitated the semiotic de-contextualisation process through the physical activities, encouraged active participation in the interpretation process, stimulated creative exploration, enhanced the recollection of theoretical concepts and supported the semiotic transference process through the co-implementation of interventions. The semiotic re-contextualisation process can be further enhanced by: explicitly explaining the importance that physical activities play during the interpretation process.

7.6.3.3. Logical Modal Agency

The Logical Modal Agency consisted of the following semiotic tools:

- Logical iconic presentation
- Logical symbolic representation
- Logical interpretation.

Figure 7.69 indicates the percentage of quotes that relates to each participant's perspective on the influence each semiotic tool had on his/her semiotic transference process.

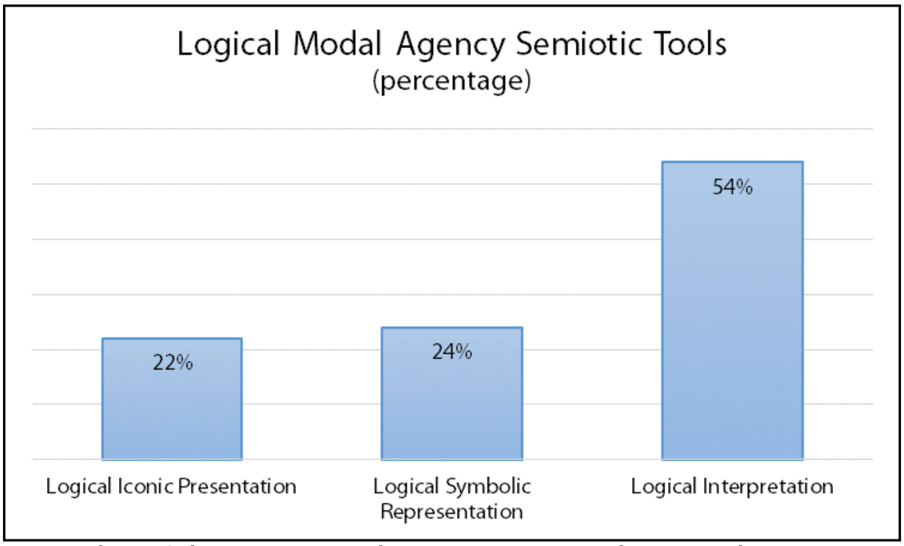


Figure 7.69: Logical Modal Semiotic Tools Perspective Analysis (Cycle 3)

a) *Logical iconic presentation*

The influence of the logical iconic presentation semiotic tool on the semiotic contextualisation process, as applied in conjunction with both the direct presentation (7.5.3.1.c) and natural iconic presentation (7.5.3.3.a) semiotic tools, was classified as either contributive or non-contributive (Table 7.39).

Table 7.39: Contribution of the logical iconic presentation semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2[80].	Repeating this modal intervention through the various theoretical concepts (theoretical concepts 1 to 3) indicated in (7.5.3.2.a), stimulated the visual sensitivity of identifying context specific icons.	***	*Another thing that helped me was examples in the nature so we took the rhythm and then we tried to find something that we can see in nature that represents the particular rhythm that we chose* (1)
	This intervention, in conjunction with both the natural iconic presentation intervention (7.5.3.2.a) and the direct presentation intervention (7.3.3.1.c), stimulated a spatial ability to visually identify and connect a context specific icon to a theoretical concept.	***	*Another thing that helped me was examples in the nature so we took the rhythm and then we tried to find something that we can see in nature that represents the particular rhythm that we chose* (1)
	The practical context specific platform, provided by the natural iconic presentation intervention, created a resource for various context specific direct semiotic links, from basic theoretical concepts like rhythm to more advanced theoretical concepts like alternating rhythm and direction.	****	Basic theoretical concepts: *example in nature, they did help a lot, the flowers that we have seen, they showed rhythm and it was easy for me to understand what rhythm really is* (14) Advanced theoretical concepts: *The nature, the nature helped the flowers because we learnt in the class that there were alternating rhythm and there was a direct, that the rhythm was giving the direction* (16)
Non-contributive: recurring from iterative cycles 1 and 2[81]	Weak semiotic link between the theoretical concept and the context specific icon, thus difficulty remembering the theoretical concept.		
	Nature was seen as not a valid resource of information (same as the natural iconic presentation intervention).		
	Low spatial sensitivity to visual signs, unable to link a theoretical concept to a context specific sign.	*	*I remember there were trees that were showing some rhythm but it helped me a little bit* (25)

This semiotic tool contributed 22% (Figure 7.69) to the perceived effect that the Logical Modal Agency had on the participants; 10 of the 11 quotes (91%) indicated that this tool contributed to their semiotic transference process (Figure 7.70).

The logical iconic presentation semiotic tool assisted the semiotic contextualisation process by using the spatial ability to visually identify and connect a context specific icon to a theoretical

[80] There were no additional contributions in iterative cycle 3.
[81] There were no additional non-contributive contributions from iterative cycle 3.

concept. The semiotic contextualisation process can be further enhanced by: developing and strengthening the context specific platform and by facilitating opportunities to create more basic visual connection activities between the theoretical concept and a context specific icon.

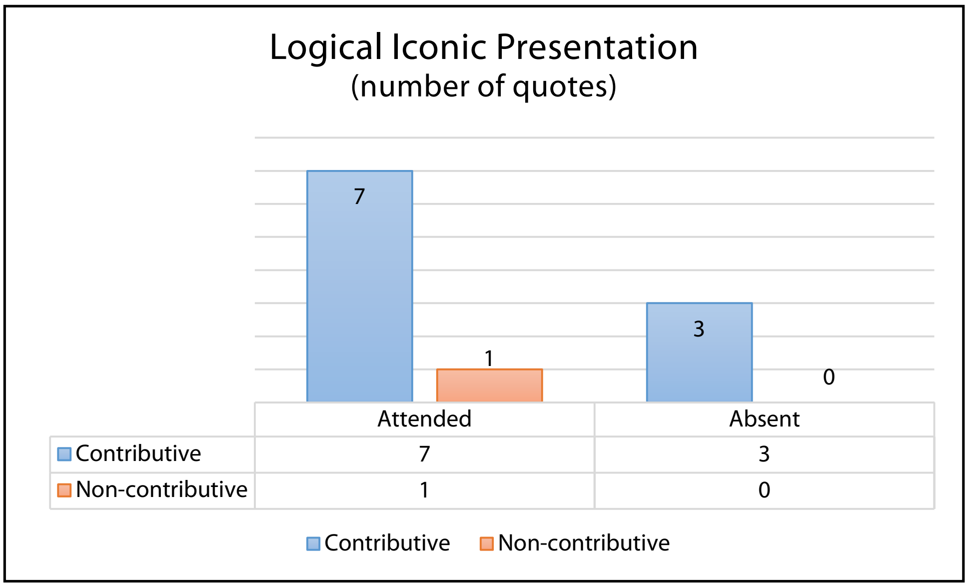


Figure 7.70: Contribution of the logical iconic presentation semiotic tool (Cycle 3)

b) Logical symbolic representation

The influence of the logical symbolic presentation semiotic tool on the semiotic re-contextualisation process, as applied in conjunction with both the indirect representation (7.5.6.3.d) and logical interpretation (7.6.3.3.c) semiotic tools, was classified as either contributive or non-contributive (Table 7.40).

Table 7.40: Contribution of the logical symbolic representation semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	Visual and verbal analogies supported the re-contextualisation transference between the Abstract Symbol and the Abstract Interpretation, stimulated the recollection of the theoretical representamen.	****	*This one reminded me of the paving that's around campus. When I saw the picture* [visual analogy], *immediately that paving pattern just came to my mind just like that* (24)
	The context specific representamen supported the semiotic transference between steps 4 to 5 of the Design Knowledge Semiotic Process (Figure 6.2).	***	*And the drawings we did from when we were outside last week and I kind of remembered the examples in nature* (25)
Contributive: Iterative cycle 3.	Developed the logical ability to understand and apply abstract symbols, able to create an Abstract Interpretation using geometric shapes.	**	*I remembered what we did the past week and I remembered the poses we did, the drawings, the examples, the nature, the small group and the big group-work. And that made able to know what to do… how to use different shapes and how to use different structures to do rhythm* (9)
	Encouraged them to understand and apply abstract symbols in various contexts.	**	*let me just say because the lecturer said that it's about rhythm, with me rhythm is with music so rhythm is something that you hear then you show it with action, like*

			move, dancing and we were doing all that stuff (4)
Non-contributive[82]: Recurring from iterative cycles 1 and 2.	A logical ineptitude to understand and apply abstract symbols, unable to use geometric shapes to re-contextualise an Abstract Symbol to an Abstract Interpretation.	*	*"And then there were drawings that were drawn. So the drawings helped me a lot because the drawings showed the different shapes and different structures but with different rhythms and then the examples in nature, I saw some examples but they did not help me a lot* (17)

This semiotic tool had a contribution of 24% (Figure 7.69) to the perceived effect that the Logical Modal Agency had on the participants; 10 of the 11 quotes (91%) indicated that this tool contributed to their semiotic transference process (Figure 7.71).

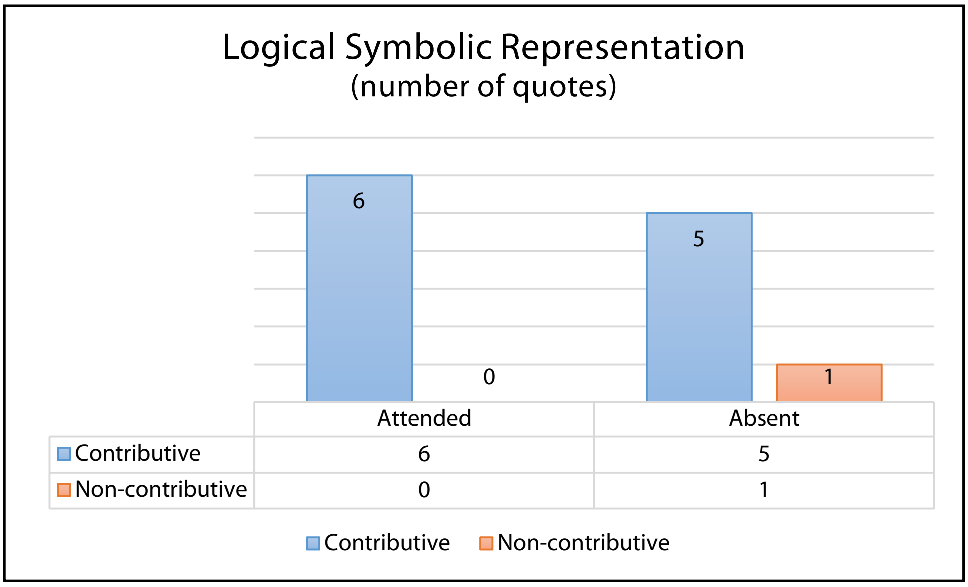


Figure 7.71: Contribution of the logical symbolic semiotic tool (Cycle 3)

The logical symbolic representation semiotic tool assisted the semiotic re-contextualisation by accessing context specific theoretic symbolic representamen to support transference between the Abstract Symbol and Abstract Interpretation. The semiotic contextualisation process can be further enhanced by: encouraging the development of various abstract symbols for each theoretical concept.

c) Logical interpretation

The influence of the logical interpretation semiotic tool (only implemented during stage 2 of the intervention) on the re-semiotisation and re-contextualisation process was classified as either contributive or non-contributive; however, for this iterative cycle it was only contributive (Table 7.41).

[82] There were no additional non-contributive contributions from iterative cycle 3.

Table 7.41: Contribution of the logical interpretation semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	Supported the re-contextualising of the context specific theoretic symbolic representamen into an abstract artefact, for example connecting an abstract visual analogy into a domain specific context artefact.	****	*was the picture that had street lights. There were street lights like all over the world. The street lights, they are the same. They show repeating of the rhythm and the paving that was outside the picture and they showed regular rhythm* (20)
	The geometric shapes simplified this process, encouraging experimentation for different design solutions and stimulated creative expression.	**	*picture had different squares* (Figure 7.72) *and the squares were like a walkway so it helped me because I wanted to make something that looked, the rhythm, it had to be bigger shape to a smaller shape. So it helped me do the shapes* (17)
	Identifying and using design precedents, incorporated previous ideas into new situations using visual and verbal analogies, acted as a resource for inspiration and direction.	****	*First of all, number 19*[83] (Figure 7.75), *it was for me, was the best rhythm. It's been used there and to try rectangles would be cool, I thought and number D* (Figure 7.73) *the whole background was grey and they emphasised with the people with the black coats in front, it looked pretty cool* (21).
	The implementation of both visual and verbal analogies stimulated recollection of existing semiotic transference processes.	****	*the pictures* [visual analogy] *are the main reason why I remembered everything that I did outside of the class. They show exactly what I know about the rhythm. They show how repetition in rhythm can lead into – can show the movement and the direction …they helped me restore all information that I've ever known about the rhythms* (14).
Contributive: Iterative cycle 3.	Developed a logical ability to think analytically about what they are seeing (*so it doesn't change on shape and size*), reflect and then link it to the known theoretical concept: *"The words, its number 3*[84] (Figure 7.76).	***	*It helped me to remember that because there was rhythm and movement but it's the same thing. So when you're repeating the same thing that's called a static movement. So it doesn't change on shape and size, those pictures* (8)
	Developed a logical ability to create divergent iterations between the theoretical concept, the sign and the Abstract Artefact.	**** **	*this picture had different squares* (Figure 7.72) *and the squares were like a walkway so it helped me because I wanted to make something that looked like alternating the rhythm…I then saw the Adidas picture* (Figure 7.75) *then I immediately saw that pattern, small, bigger, small. Yeah, that's how I understand to use that shapes for progressive rhythm* (17)
Non-contributive: Recurring from iterative cycles 1 and 2.	The use of geometric shapes to re-contextualise an Abstract Symbol to an Abstract Interpretation restricted the creative process.		
	Some of the verbal analogies were not clear and were perceived as limiting.		

[83] Reference to the visual analogical representations that was on the wall.
[84] Reference to the visual analogical representations that was on the wall.

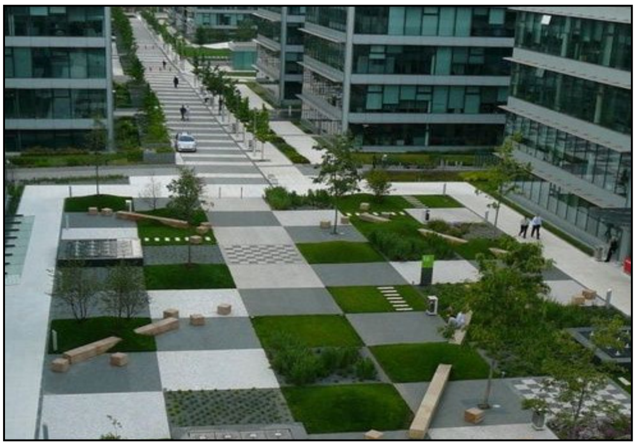


Figure 7.72: Visual analogy that represents alternating rhythm.
Source: www.architectureus.com

Figure 7.73: Visual analogy that represents rhythm, example 19.
Source: www.paulterrysutton.wordpress.com

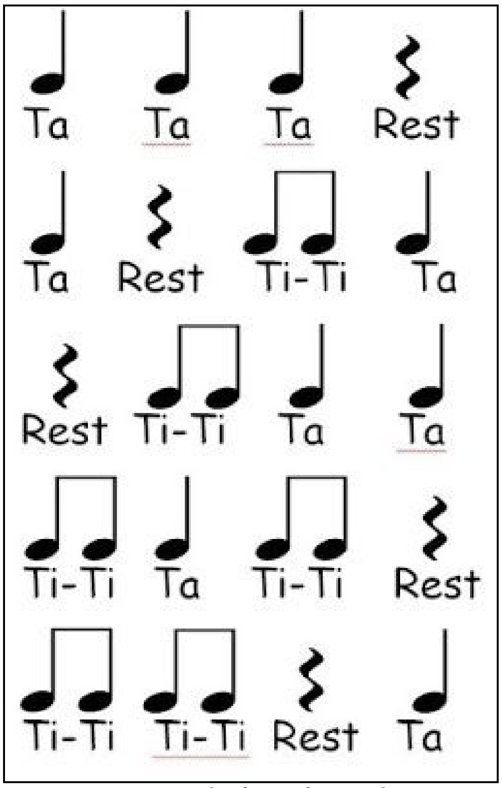


Figure 7.74: Verbal analogy that represents rhythm, example 3.
Source: www.musicforhomeschoolers-loretta.blogspot.co.uk

Figure 7.75: Visual analogy that represents progressive rhythm.
Source: www.thelogofactory.com

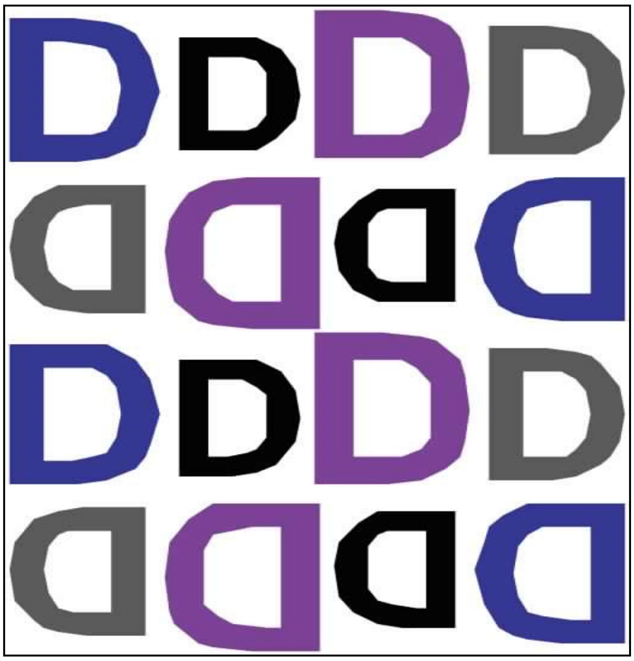


Figure 7.76: Verbal analogy that represents rhythm, example 21.
Source: www.writedesignonline.com

This semiotic tool had the highest contribution (54%) (Figure 7.69) to the perceived effect that the Logical Modal Agency had on the participants, all the quotes (100%) indicated that this intervention contributed to their semiotic transference process (Figure 7.77).

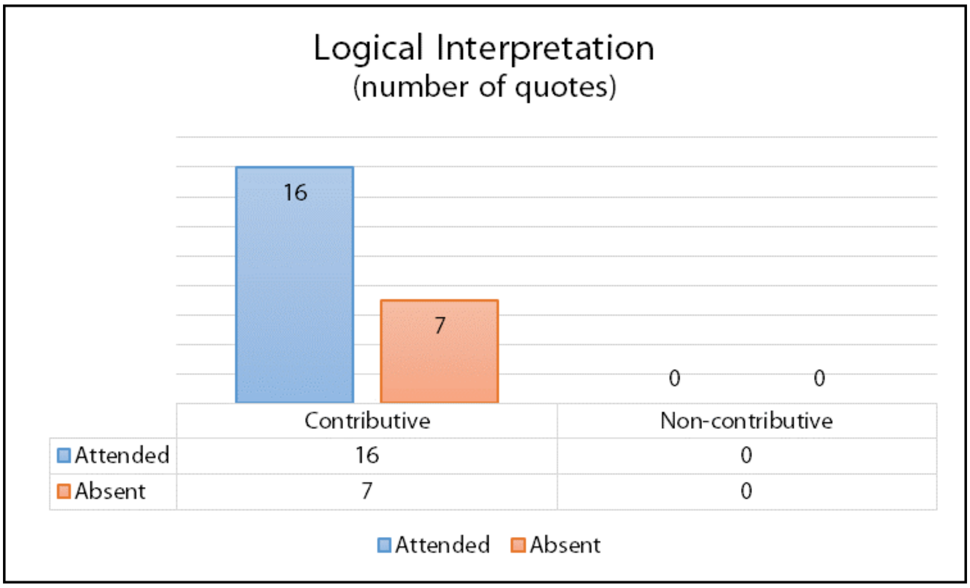


Figure 7.77: Contribution of the logical interpretation semiotic tool (Cycle 3)

The logical interpretation semiotic tool assisted the re-semiotisation and re-contextualisation process by the development of the logical ability to understand analytically and to think divergently about design solutions, and also to incorporate design precedents into their semiotic transference process. The semiotic re-contextualisation process can be further enhanced by: implementing various design assignments to de-contextualise and re-semiotise various representamen into abstract artefacts.

7.6.3.4. Emotional Modal Agency

The Emotional Modal Agency consisted of the following semiotic tools:

- Group-Work
- Friends/peers discussion
- Individual reflection
- Self-Study

Figure 7.78 indicated the percentage of quotes that relates to each participant's perspective on the influence each intervention had on his/her semiotic transference process.

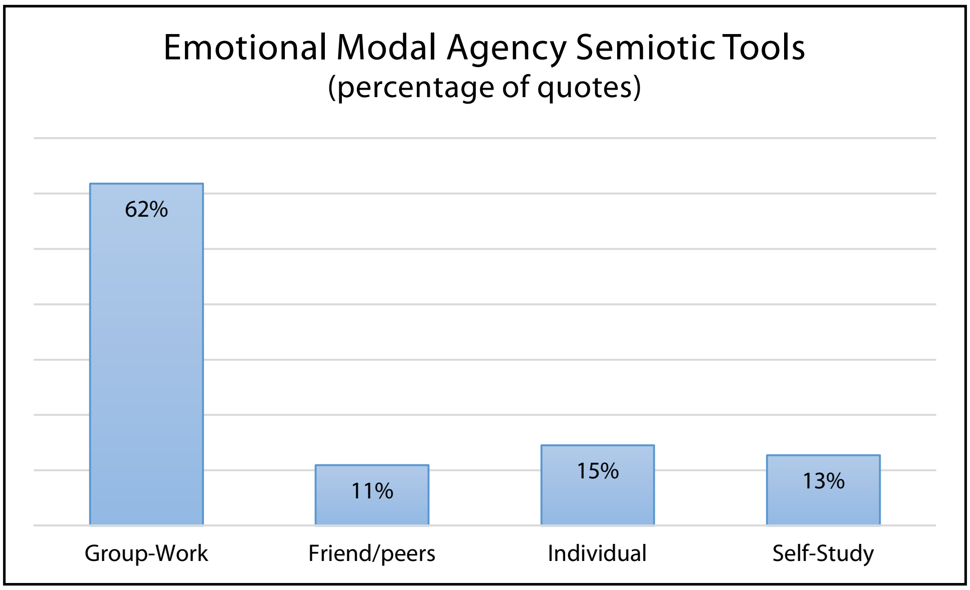


Figure 7.78: Emotional Modal Agency Semiotic Tool Perspective Analysis (Cycle 3)

a) Group-Work

The influence of the group-work semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.42).

Table 7.42: Contribution of the group-work semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: Recurring contributions from iterative cycles 1 and 2.	Created an environment that encouraged collaborative learning, supporting the transference of knowledge and skills.	*****	*Working in groups was good because you can now learn how to communicate to accommodate the different ideas* (group interview)
	Facilitated creative interaction between group members.	**	*But in a big group I felt more like active because lots of people, more ideas, more contribution* (group interview)
	Collaborative learning created a supportive learning environment, created a sense of belonging.	***	*Being outside was fun because when we were outside we're interacting with the lecturer than we're working in class because when we are in class we are just sitting and listening to what the lecturer is saying. But when we are outside we are practically doing what the lecturer is saying* (group interview)
Contributive: Iterative cycle 3.	The large group concept created a bigger resource of knowledge and supported the meaning making process of that knowledge, bridging the language barrier and providing various perspectives on that theoretical concept and reducing misunderstanding.	*******	Knowledge resource: *big group was really helpful because the guys were coming with ideas and then from their experience I could relate to what rhythm is* (14) Supported meaning making: *And in a big group, we had to make – do like poses and stuff with a big group and if I don't understand then we'll do it as groups so that will help me too* (9) Bridging the language barrier: *The big group, we were four so everyone gave their own opinion to what – if I don't understand, I would ask someone in my group to please explain to me what Mr Griesel wants us to do* (20) Providing various perspectives:

			the big group you can – lots of people can put input, more input in and we can help each other understand the work (23)
	The 'study-buddy' concept, where each participant was co-responsible for another participant, supported the semiotic process by creating a supportive learning environment that provided: additional resources of information, supported the explanation of theoretical concepts (bridging the language barrier), enabled collaborative learning by encouraging active participation and social interactions - thus creating a safe collaborative learning environment.	**** ***	Resources: *Last week, I did not attend so my study partner got me the notes and then I had to still study the notes* (7) Supported transfer of knowledge: *The study buddy helped me. He told me what they did on that day since I wasn't there. So now he explained everything to me and then I got a clue what happened* (15) Bridging the language barrier: *She explained to me what was going on, what was on the notes so that I can understand better* (16) Encouraged active participation: *And the small groups were divided into – and we were discussing and we had to make rhythm using our hands and the physical activities which include the small group-work* (20) Social interactions: *Because there we worked in smaller groups, like my study buddy and like I said, I have a good study buddy and help each other a lot. So the [inaudible] was good, it was good working with him* (21) Safe collaborative learning environment: *The small group, I felt comfortable because I understand my study buddy and sometimes he helped me with something I didn't know and I helped him with other things* (group interview).
Non-contributive: Recurring from iterative cycles 1 and 2.	A resistance to working in groups.		
Non-contributive: Iterative cycle 3.	Group members not participating.	***	*The big group-work didn't help me that much because my peers were lazy so I had to work alone* (8)
	The 'study-buddy' not attending.	**	*"my study buddy, he was not in class the last time and then, so he didn't help* (14)

Accumulative to the contributive influences that emerged from iterative cycles 1 and 2, i.e. contributions of the group-work semiotic tool in facilitating the transference of knowledge, and also creating a supportive environment for collaborative learning processes, were the contributive influences that the sizes of groups (Figure 7.79), the group-work process model (further referred to as large groups) and the 'study-buddy' concepts had on the semiotic transference process.

The addition of the group-work process/large groups and the 'study-buddy' concepts to this intervention required not only collaborative learning:

> *Working in groups was good because you can now learn how to communicate to accommodate the different ideas* (group interview),

but also engaged them, through the various activities, in their own semiotic transference process:

> *Being outside was fun because when we were outside we're interacting with the lecturer than we're working in class because when we are in class we are just sitting and listening to what the lecturer is saying. But when we are outside we are practically doing what the lecturer is saying* (group interview).

The combination of both concepts supported this process:

> *the examples, the nature, the small group and the big group-work. And that made able to know what to do* (9).

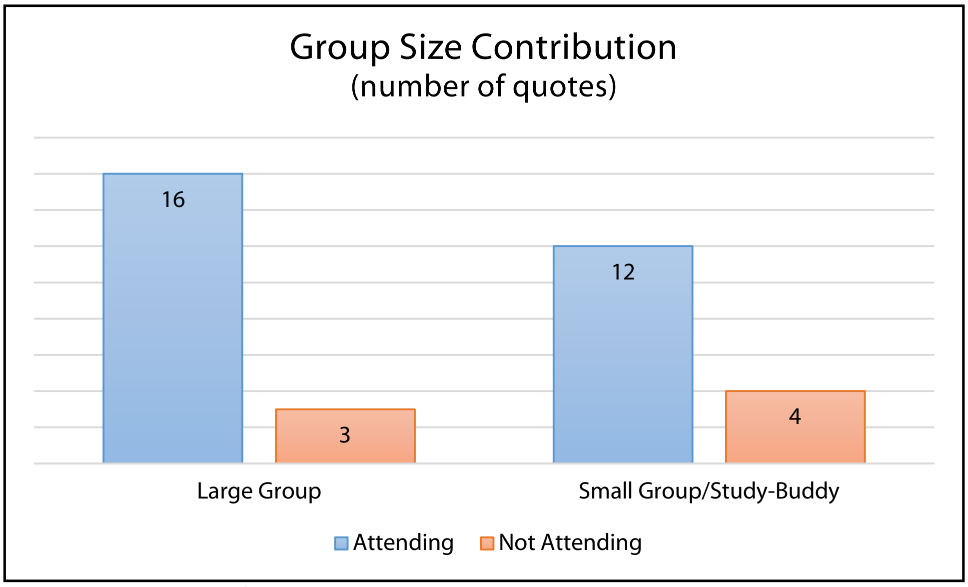


Figure 7.79: Contribution of the group size additional semiotic tools (Cycle 3).

This semiotic tool had the highest contribution (62%) (Figure 7.78) to the perceived effect that the Emotional Modal Agency had on the participants; 27 of the 35 quotes (77%) indicated that this tool contributed to their semiotic transference process (Figure 7.80):

> *I think it's going to help us a lot. We just know that somebody is going to explain it better for me if I didn't hear it clearly in class. So it's going to help us a lot* (group interview).

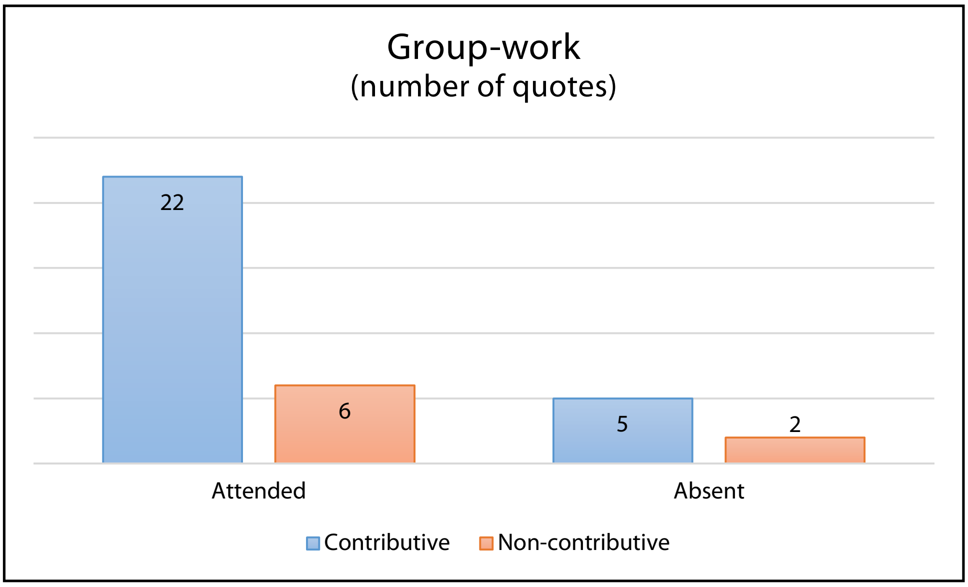


Figure 7.80: Contribution of the group-work semiotic tool (Cycle 3).

The group-work semiotic tool acted as a facilitation agent that assisted the semiotic processes of theoretical concepts by facilitating knowledge transference activities and by creating a supportive environment for collaborative learning processes. The semiotic contextualisation process can be further enhanced by: enabling the group to facilitate different activities in different theoretical concepts, and by incorporating group-work in all the steps of the modal agency meaning making process.

b) Friends/peers discussion

The influence of the friends/peers discussion semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.43).

Table 7.43: Contribution of the friends/peers discussion semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: recurring contributions from iterative cycles 1 and 2[85].	The verbal resources of "others" supported semiotic transference between the theoretical concept and the sign.	***	*what helped me outside the classroom was my friends and peers when they explained to me about the reading* (17)
	Encouraged collaborative learning through the creation of a supportive social environment.		
	Assisted the absent participants' semiotic transference by providing theoretical resources.		
	Facilitated collaborative learning by extending the learning process into a social environment.		
	Sustained the semiotic transference by assisting recollection.	*	*I was looking at the pictures and there was just movement. The drawings were like moving. <u>So I remembered a friend told me</u>*

[85] There were no additional contributions from iterative cycle 3.

			about movement and direction so it was fine (6).
	Instigating active interaction with the meaning making process.		
Non-contributive: recurring from iterative cycles 1 and 2.	Insufficient information from friends.	*	*friends and peers didn't help a lot, they didn't know what rhythm is. They didn't know* (14).
	Friends could not successfully explain the theoretical concepts.	*	*I heard from friends that they were doing rhythm and what does rhythm – it's all about. So I didn't get much information* (6)

This semiotic tool had the lowest contribution, namely 11% (Figure 7.78), to the perceived effect that the Emotional Modal Agency had on the participants. Only two of the six quotes (33%) indicated that this tool contributed to their semiotic transference process (Figure 7.81), only the absent participants reflected the effect as contributive.

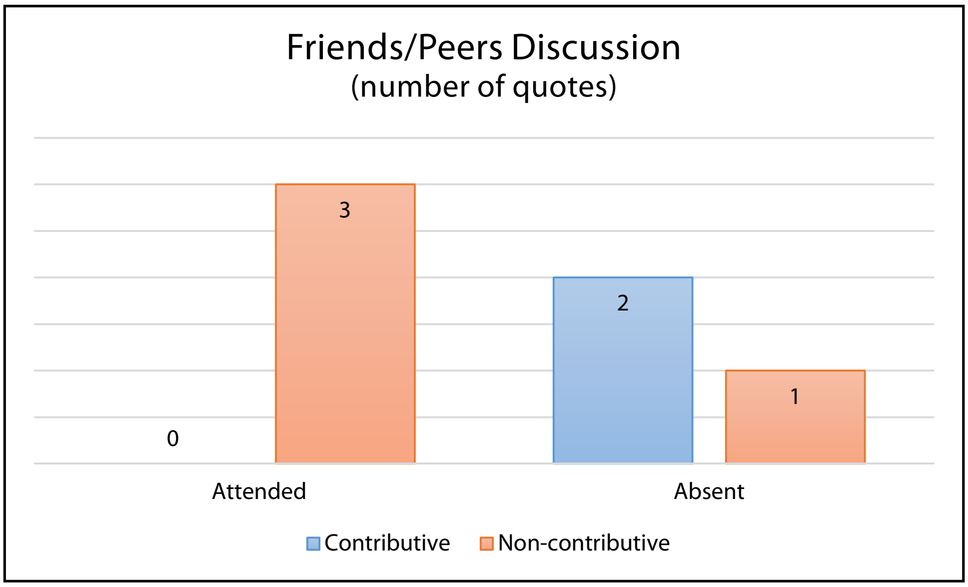


Figure 7.81: Contribution of the friends/peers discussion semiotic tool (Cycle 3).

The friends/peers semiotic tool minimally contributed as a facilitation agent that assisted the semiotic processes of theoretical concepts by providing the resources of 'others', facilitating extended and collaborative learning, and by creating a prompting and reflective resource. The semiotic contextualisation process can be further enhanced by: encourage the use of friends/peers as an important information resource, and create a collaborative learning and reflective environment that encourage friends/peers to assist in explaining the theoretical concepts, but also reassessing how that knowledge was perceived.

c) Individual reflection

The influence of the individual reflection semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.44).

Table 7.44: Contribution of the individual reflection semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: recurring contributions from iterative cycles 1 and 2.	Encouraged individuals to actively participate in their own learning process and to use their own personal knowledge they had on the theoretical concept to facilitate the semiotic transference process.	***	*I remembered that I had experience in music. So since I am so much into music, I could remember that in music we did rhythm and you could tell that oh, the tempo if it goes like this and then that's how I understood rhythm through my knowledge in music* (14)
Contributive: Iterative cycle 3.	Created an opportunity for individuals who prefer working alone to actively participate in their own learning process.	*	*For someone like me, I like to do things on my own* (8)
Non-contributive: recurring from iterative cycles 1 and 2.	Working individually was perceived to limit creativity and non-contributive to the semiotic transference process.		
	Failure to comprehend the relevancy of nature (specific context) the same as the natural iconic intervention; both of them were implemented during the same activity.		
Non-contributive: Iterative cycle 3.	A low sense of self-efficacy, the individuals' self-perceptions of their own creative competency, discouraged them to individualise their own learning process.	****	*Individual work, when I'm thinking individual it's like I'm not thinking the right things you see* [low self-efficacy]. *So when I want to explore ideas I want to have somebody to talk to and say this is what I think and hear that person, what he or she thinks or if my idea is okay, we can use it you see* (24) *My individual work, it didn't work because that's the one that I didn't know after having gone through the notes* (14)

This semiotic tool had a low perceived effect (15%) (Figure 7.78) on the contribution that the Emotional Modal Agency had on the participants; four of the eight quotes (50%) indicated that this tool contributed to their semiotic transference process (Figure 7.82). It had no perceived effect on the absent participants.

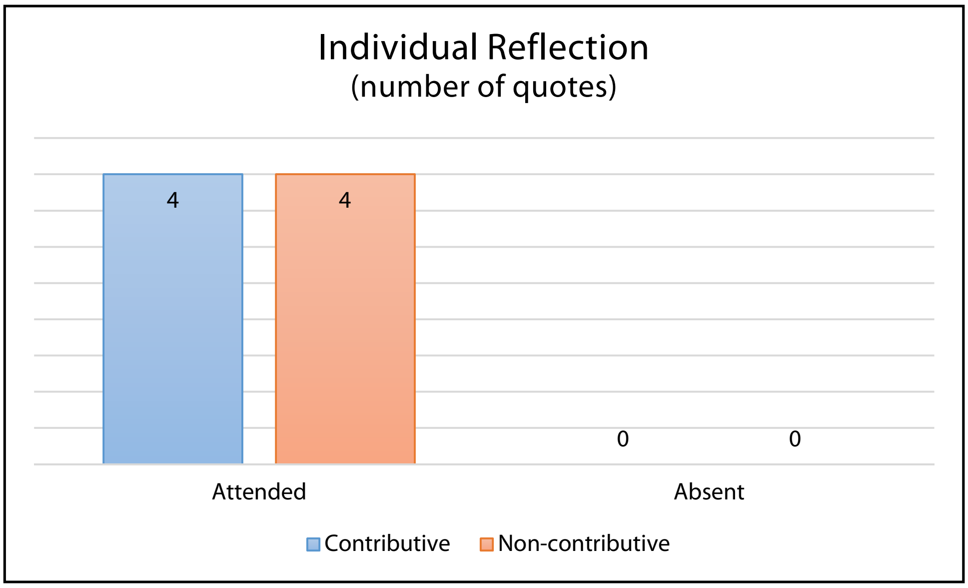


Figure 7.82: Contribution of the individual reflection semiotic tool (Cycle 3).

The individual semiotic tool encouraged the reflection of the individuals' existing resources of knowledge and to incorporate that to facilitate their own semiotic process. The semiotic contextualisation process can be further enhanced by: encouraging the implementation of this intervention in all the steps of the modal agency meaning making process, and by creating a platform to develop each individual's creative self-efficacy.

d) Self-Study

The influence of the self-study semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.45).

Table 7.45: Contribution of the self-study semiotic tool (Cycle 3)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: recurring contributions from iterative cycles 1 and 2.	Encouraged and facilitated extended individual learning.	**	*Self-study it was helpful because <u>I've done the research on the internet w</u>hat exactly is rhythm and then I researched the repetition of the rhythm, the regular rhythm* (22)
Contributive: Iterative cycle 3.	The preparatory assignment introduced the theoretical concept and promoted understanding and expectations.	*	*It will help us because <u>you will have a clue what you are going to talk about in class</u> because you're going to be giving us something that you are going to teach us* (group interview)
Non-contributive: recurring from iterative cycles 1 and 2.	The theoretical content course material did not support self-study.	**	*Well before we did these rhythms in nature we were given the notes to just go home and study on your own and then draw something after the part you have understood. I took the notes and they didn't help a lot that's why the circle of the notes is so small. I didn't even know what to do. I didn't even start to draw. So the notes alone were not helpful* (16)
Non-contributive: Iterative cycle 3.	The English language and reading skills barrier, that some of the participants at CPUT faced, caused reading and	**	*We had to read through the thing of the rhythm but I couldn't understand a single word on the page. I was like I don't know the words* (group interview)

	understanding the notes to be problematic.		

This semiotic tool only contributed 13% (Figure 7.78) to the perceived effect that the Emotional Modal Agency had on the participants; only three of the seven quotes (43%) indicated that this tool contributed very little to their semiotic transference process (Figure 7.83).

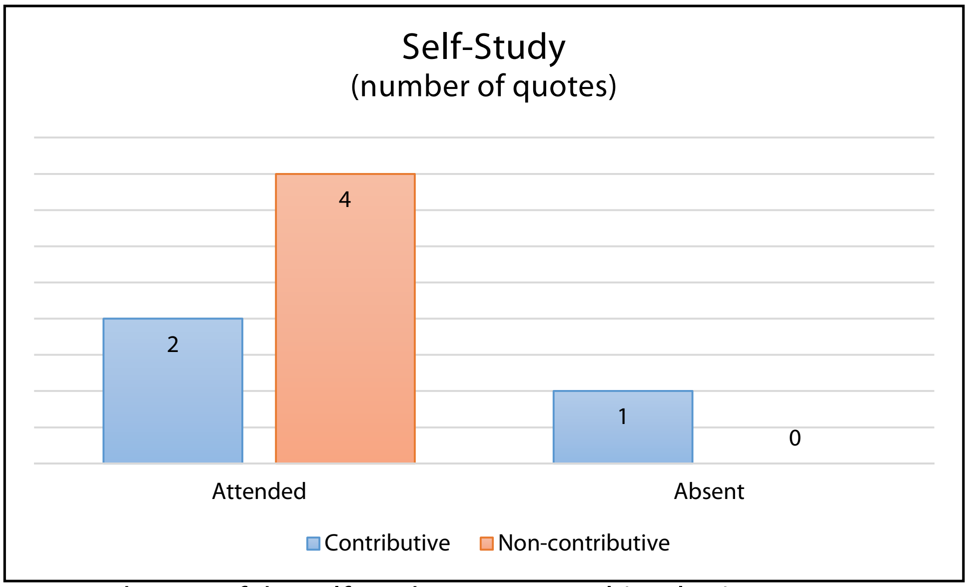


Figure 7.83: Contribution of the self-study semiotic tool (Cycle 3).

The self-study semiotic tool minimally encouraged the individual to become the facilitating agent for his/her own semiotic contextualisation process. The semiotic contextualisation process can be further enhanced by: implementing of this tool before step 1 in the modal agency meaning making process, and by encouraging the participants to individually find more resources of the theoretical concepts.

7.6.4 Overall reflection after iterative cycle 3

The qualitative data on the perceived contribution of all the modal agencies on each of the participants' semiotic transference process were quantified and indicated in Figure 7.84. The bar graph clearly indicates the contributive value variance of each semiotic tool on every participant. Overlaying that graph with the scores from design assignment 4 (Figure 7.85), indicates a comparison between perceived contribution of the modal agencies and how it contributed to re-semiotisation and re-contextualisation of a theoretic concept into an abstract artefact.

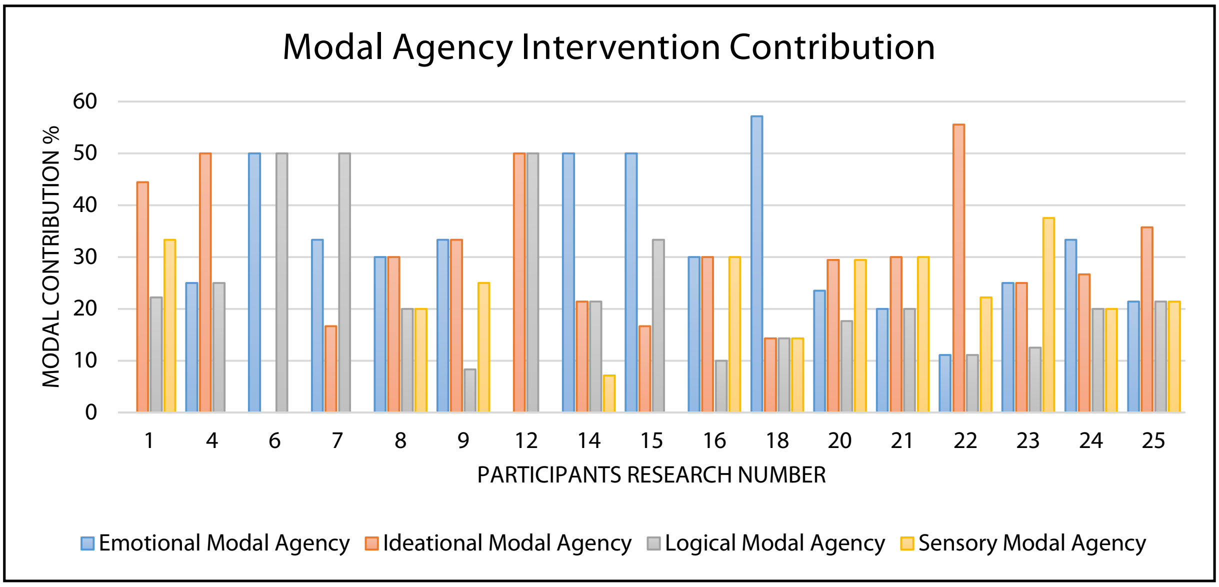


Figure 7.84: Contribution value of the modal agency intervention (Cycle 3)

The modal agency intervention created a platform that not only contributed to each individual participant's semiotic processes, but also facilitated an authentic, domain specific, teaching and learning environment that encouraged collaborative learning.

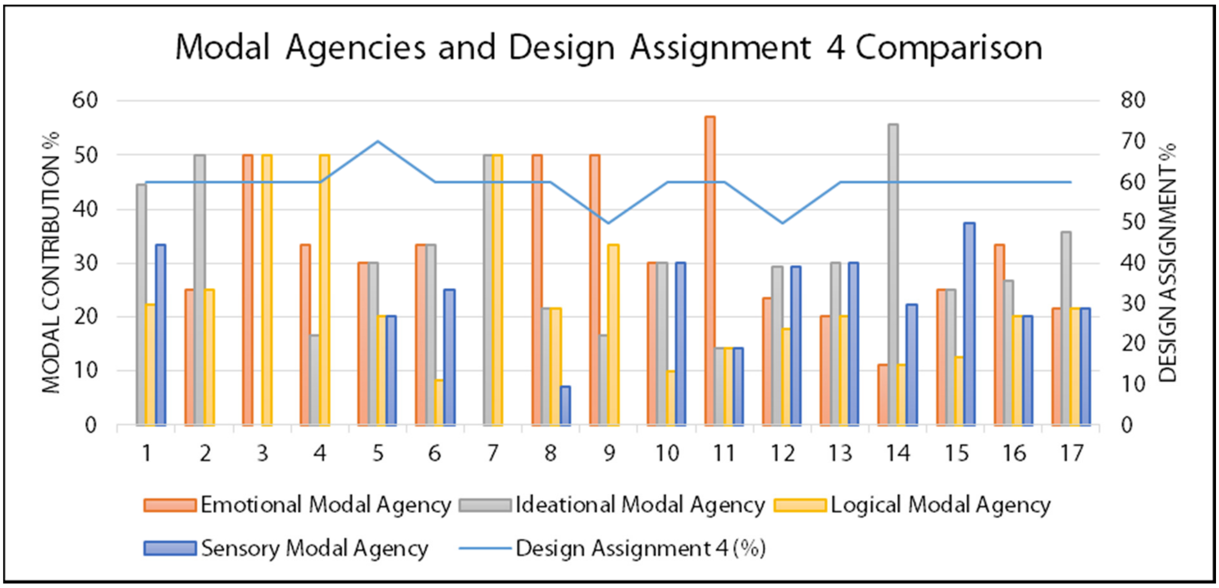


Figure 7.85: Comparison of the modal agencies with Design Assignment 4 (Cycle 3)

The participants recognized the outdoor natural teaching and learning environment as a domain specific information resource, contributing to the connection of the theoretical concepts to the specific environmental context.

The following issues must be addressed in iterative cycle 4 to further enhance the semiotic contextualisation process:

- Integrating the theoretical content course material into the Self-study and 'study-buddy' semiotic tools to address the reading challenges the participants faced;
- Handing out the content course material one week before the next intervention, together with the preparative assignment to encourage self-study;
- Create drawings, small and large scale, spaces within the notes to encourage interaction with the notes during the intervention or class and forcing them to think in different scales;
- Positioning this drawing activities with individual and 'study-buddy' environment, allowing for formative feedback;
- Introducing the preparatory assignment with a verbal introduction to address the language challenges the participants faced;
- Incorporating the group-work intervention with the introduction of the theoretical concept to address the language challenges the participants faced;
- Encouraging and facilitating the 'study-buddy' concept, making the participants to feel comfortable with their 'study-buddy'; create an activity to facilitate the bonding between the study-buddies;
- Encouraging the participants to verbally engage with their own learning process, enhancing their verbal skill set;
- Explicitly explaining the purpose of the group-work process model as a collaborative knowledge transfer process tool;
- Co-implementing the group-work intervention with the verbal presentation intervention to reduce the language barrier;
- Highlighting the domain specific context, the natural environment, as an important information resource for Landscape Architecture;
- Encouraging reflection between what they did practically and theoretically; can they create a link, differentiating between different concepts;
- Co-implementing all the interventions as the facilitating agents, creating fixing nodes in meaning making;

- Aligning each drawing assignment to specific theoretical concepts, creating spatial organisation and visualisation skills;
- Encouraging the expression of theoretical concepts through physical activities during the different types of group-work activities, creating sensitivity to human scale and ergonomic and accessibility;
- Reducing the context specific, direct representational visual and verbal analogies and introducing more abstract and domain specific visual and verbal analogies; and
- Implementing various design assignments to de-contextualise and re-semiotise various representamen into abstract artefacts.

7.7 Iterative cycle 4

This cycle was the last of the iterative cycles and was implemented during the last week of August 2017 (Figure 7.86). Table 7.46 showed how meaning was transferred from the theoretical concept, for this iterative cycle 'scale and proportion' (section 7.6.1), through the modal agency meaning making process intervention (Figure 7.2).

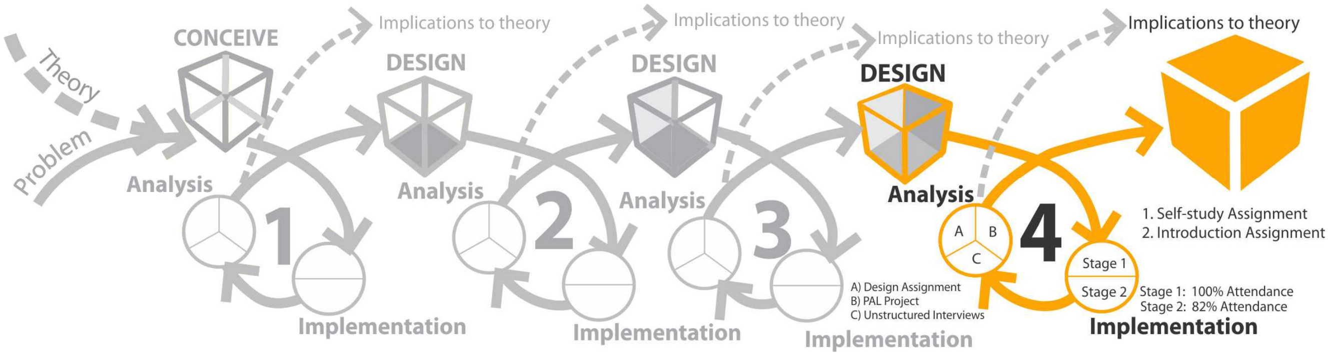


Figure 7.86: Iterative cycle 4

The following intervention concepts were developed and included in the modal agency meaning making process after the reflection and analysis of iterative cycle 3 had been completed:

- Self-study assignment:
  The original concept from iterative cycle 3 was further developed by implementing a blended learning method that encouraged the participants to interact with their preparatory assignment through various media and technologies. This was implemented a week before the last iterative cycle was implemented. This was also introduced in the Emotional Modal Agency semiotic tools.
- Introduction assignment:
  The concept was to introduce a theoretical concept by means of the group-work process model. Group-work, through collaborative learning, creates the platform that assists the semiotic transference process by providing the language resources of 'other', reducing the language barrier with which the participants were struggling.

7.7.1 Basic Design Principle: Scale and proportion

Historically, designers have used scale and proportion to depict or distract from the ideal. As with other design principles such as rhythm and balance, designers use scale and proportion to convey their unique insights to the viewer. Scale and proportion are both design principles that have to do with size. Size is the physical dimensions of an object. Scale is the relative size of different objects in relation to each other or a common standard (Bradley, 2010). Proportion is harmony of scale. The lesson focused on the following principles of scale and proportion, divided them up into the following concepts:

- Concept 1: Scale
  Scale refers to the size of an object (a whole) in relationship to another object (another whole). In design, the size relationship between an object and the human body is significant. In experiencing the scale of an object we tend to compare its size to the size of our own bodies (Lamp, 2012).

- Concept 2: Proportion
  Proportion refers to the relative size of parts of a whole (elements within an object). We often think of proportions in terms of size relationships within the human body (Lamp, 2012).

Table 7.46 : Iterative Cycle 4 modal agency intervention – Stage 1

Theoretical Concept	DKSP Steps	Modal Agency and Semiotic Tools	Activity
Preparatory assignment - size - one week in advance	1	Emotional Modal Agency: - Self-Study	Each participant received a link to a YouTube video (https://www.youtube.com/watch?v=RrxO6SZAVb4). After they had watched the video, they had to complete an assignment.
Introduction - scale and proportion - in class	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally introduced the theoretical concept in class and explained the link between the theoretical concepts and the context.
	1	Ideational Modal Agency: - the theoretical content course material	Each participant received the theoretical content course material.
Concept 1: Scale (Outdoors)	1	Ideational Modal Agency: - Verbal Presentation Emotional Modal Agency: - Group-work - Individual	The participants were divided into five large groups. An introduction assignment about relative size was discussed and each group received six questions they had to discuss. Each participant received an introduction assignment hand-out and they had to complete certain questions with their 'study-buddy', as well as individually.
	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally explained the concept of scale.
	2	Ideational Modal Agency: - Verbal Presentation Emotional Modal Agency: - Group-work	Each large group discussed: - the concept of scale, and - why must landscape elements relate to human scale?
	2	Ideational Modal Agency: - Direct Presentation Sensory Modal Agency: - Kinesthetic Expression Emotional Modal Agency: - Group-work (small groups) Logical Modal Agency: - Logical Iconic Presentation	Each 'study-buddy' group was asked to draw the following anthropometric scale drawings: - themselves with dimensions (Figure 7.87)(Figure 7.88); - section of a bench with dimensions and themselves standing next to it; - section of the pergola with dimensions and themselves standing under it.
	3	Ideational Modal Agency: - Indirect Presentation	Each participant had to identify and draw in his or her notes an example where emphasis is created through scale.

		Logical Modal Agency: - Symbolic Representation Sensory Modal Agency: - Natural Iconic	
	4	Ideational Modal Agency: - Indirect Representation Sensory Modal Agency: - Kinesthetic Expression Emotional Modal Agency: - Group-work Logical Modal Agency: - Symbolic Representation	The 'study-buddy' groups had to create an abstract composition using leaves that represent emphasis through scale.
	3	Ideational Modal Agency: - Indirect Representation Sensory Modal Agency: - Kinesthetic Drawing - Kinesthetic Expression Emotional Modal Agency: - Group-work Logical Modal Agency: - Logical Symbolic Representation	Each large group had to identify a tall landscape structure, i.e. a tree or lamppost. One of the group members stood next to the object and the rest of the group stepped backwards until they could easily measure the height of the student's body with that of the structure, i.e. 4 body lengths. Create or draw the following scale representations: - Create a 1:1 representation of that structure with their bodies (Figure 7.89); - Create a 1: 2 representation of the structure with their bodies; - Create a 1: 5 representation of the structure with their bodies; - Draw a 1:10 representation of the structure in the notes; and - Create a 2:1 representation of the structure with their bodies.
	4	Ideational Modal Agency: - Verbal Presentation - Indirect Representation Sensory Modal Agency: - Kinesthetic Expression Logical Modal Agency: - Logical Symbolic Representation	Each large group: - Identified and discussed authority through scale in the landscape; - Created larger than human scale sculptures with their bodies that emphasised authority through scale (Figure 7.90).
	4	Ideational Modal Agency: - Indirect Representation Emotional Modal Agency: - Group-work	The 'study-buddy' groups had to identify and draw an example where perspective was created through scale.
<u>Concept 2:</u> Proportion (Outdoors)	1	Ideational Modal Agency: - Verbal Presentation	The lecturer verbally explained the concept of proportion.
	2 and 3	Ideational Modal Agency: - Verbal Presentation - Direct Presentation Sensory Modal Agency: - Natural Iconic Emotional Modal Agency: - Group-work	Each large group: - Discussed the concept of proportion, and - Identified and drew an example of a landscape element that is in proportion.
	3 and 4	Ideational Modal Agency: - Direct Presentation - Indirect Representation	The 'study-buddy' groups had to: -Identify an discuss a disproportional landscape element;

		Sensory Modal Agency: - Kinesthetic Drawing Emotional Modal Agency: - Group-work Logical Modal Agency: - Logical Iconic Presentation - Logical Symbolic Representation	- Discuss the reason why it was disproportional; - Create a drawing, 1 x 1 meter, with chalk that represents emphasis through disproportion.

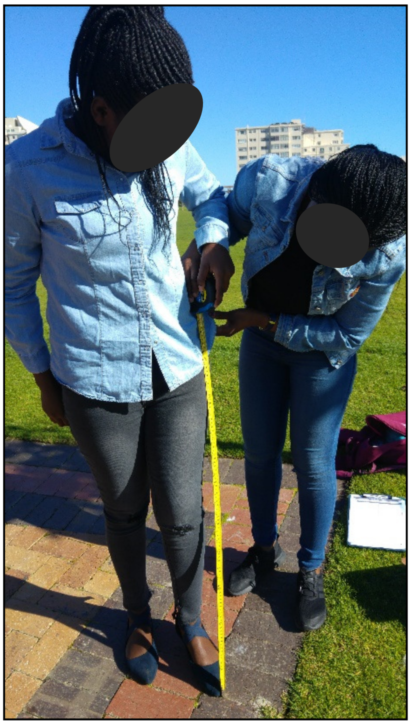


Figure 7.88: Anthropometric measurements exercise.
Source: Author

Figure 7.87: Anthropometric measurements exercise.
Source: Author

Figure 7.89: Lamp post 1:1 representation.
Source: Author

Figure 7.90: Authority through scale sculpture
Source: Author

7.7.2 Qualitative analysis of the Design Assignment 5 (Stage 2)

The outcome of the design assignment 5 was evaluated on an achievement scale of 1 to 5 (see design assessment rubric in Addendum F). Two independent assessors evaluated the design assignments objectively and the average of the assessment results was analysed for each task. The Cronbach Alpha tests of inter-observer reliability for different combinations of two assessors indicated a valuable reliability of 0.89 between the two assessors on each task.

A detailed table of the results obtained by the participants in design assignment 5 is presented in Addendum H. The scores were standardised (Table 7.47). Taken together, the average scores ranged from 3 (only one composition represented a correct concept; the design idea/solution did satisfy the design requirements) to 5 (excellent examples of the different concepts in the composition; the design idea/solution did satisfy the design requirements) with a mean score of 4 (both compositions represented the required concepts; the design idea/solution did satisfy the design requirements). The bar chart for the average scores of each participant is shown in Figure 7.91. The average score of 4 (score level of 80%) indicates that half of the participants scored 80% and above, with the highest number of participants (5) in the score frequency interval between 4.5 and 4.9 (Figure 7.92). The minimum score of 3 (score level of 60%) highlighted that all the participants were at least able to successfully create one interpretation of scale, but still struggled to completely satisfy all the requirements of the assignment.

Table 7.47: Descriptive statistics for Design Assignment 5

Design Assignment 5: aggregate scores	
Mean	3.92
Standard Deviation	0.60
Minimum	3
Maximum	5

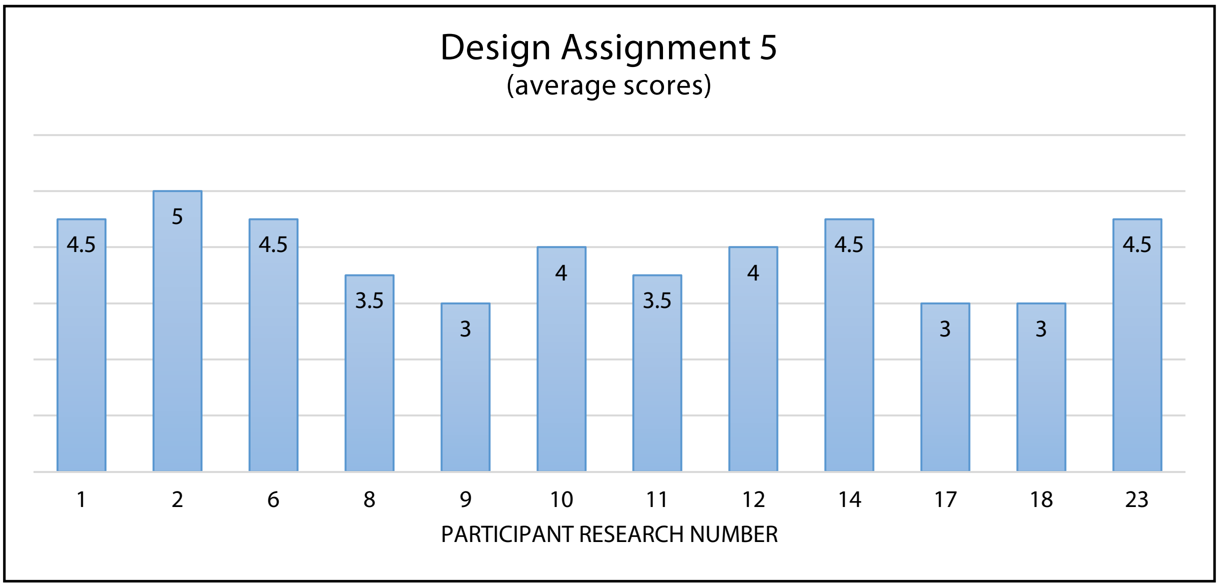


Figure 7.91: Average scores for Design Assignment 5.

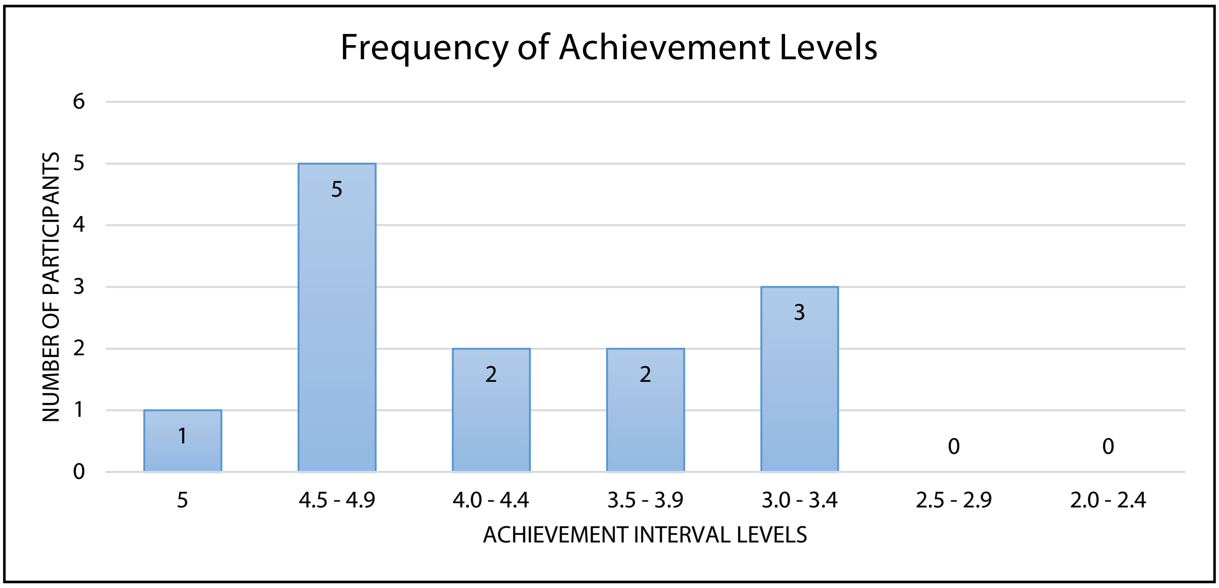


Figure 7.92: Frequency of achievement levels in Design Assignment 5 (Cycle 4)

7.7.3 Quantitative analysis of the Modal Agencies Intervention (Stage 1)

The Modal Intervention consisted of the following agencies:

- Ideational Modal Agency
- Sensory Modal Agency
- Logical Modal Agency
- Emotional Modal Agency.

Figure 7.93 indicates the percentage of quotes that relates to each participant's perspective on the influence each modal agency had on his/her semiotic transference process.

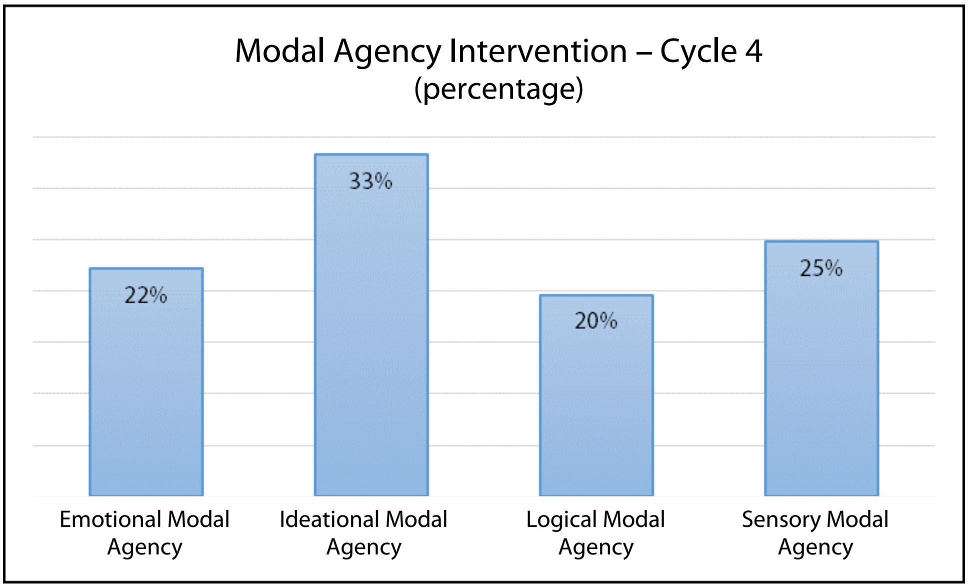


Figure 7.93: Modal Agency Intervention Perspective Analysis (Cycle 4)

7.7.3.1. Ideational Modal Agency

The Ideational Modal Agency consisted of the following semiotic tools:

- Theoretical content course material
- Verbal presentation
- Direct presentation
- Indirect representation.

Figure 7.94 indicates the percentage of quotes that relates to each participant's perspective of the influence each semiotic tool had on his/her semiotic transference process.

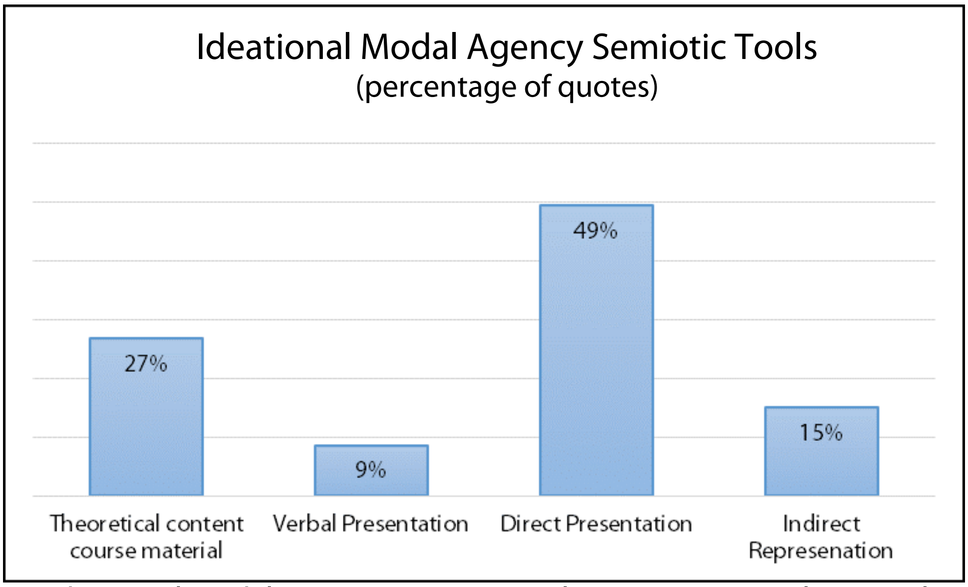


Figure 7.94: Ideational Modal Agency Semiotic Tools Perspective Analysis (Cycle 4)

a) Theoretical content course material

The influence of the theoretical content course material (notes) semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.48).

Table 7.48: Contribution of the theoretical content course material semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[86]: Recurring contributions from iterative cycles 1, 2 and 3.	Supported the creation of visual and verbal links between the theoretical concept and the sign (icon or symbol).	*	*So the examples in nature, I saw them live. And then the others, it was just the talking and then the notes, they were written down, I saw the things and then I understood it from seeing it* (17)
	Provided a theoretical resource that facilitated the interpretation process beyond the classroom context.		
	The notes sustained semiotic transference by becoming a reflective and prompting resource, assisting the	***	*Remembering everything… the notes is what helped me to go through this work* (14)

[86] There were no additional contributive contributions from iterative cycle 4.

	recollection of the theoretical concepts.		
	The affordance of various context specific and abstract visual representamen in the notes supported semiotic transference.		
	The additional spaces for note taking and drawing encouraged interaction with the semiotic transference process.	*	*The notes represent the tools that helped me to understand the session that we've done* (22)
	The physical action of drawing signs in the notes supported the visual recollection process of the theoretical concepts.	***	*I love drawing and in the notes there was place for us to draw and that helped me a lot because we can see the things and draw it down so we can remember it* (23)
Non-contributive Recurring from iterative cycles 1, 2 and 3.	The English language and reading skills barrier, that some of the participants at CPUT faced, caused reading and understanding the notes to be problematic.	**** ****	*When we arrived we were given notes and I didn't read the notes. Okay, <u>I tried but I did not understand them so they didn't help</u>* (9) *And then the notes didn't help a lot because – <u>eish I'm not a fan of reading</u> so I didn't even bother reading at home* (11)
	Resistance to reading due to a perception that notes are only there for assessment and not for understanding.		
	Reading alone did not create a strong semiotic link between the theoretical concept and the sign, thus struggling to remember that link.		
	The visual link between the written text and the images in the notes were not emphasised enough.	***	*The notes that we had, they did not give me a clear picture of scale and proportion* (14)
	A perception among some participants that, if they understood the theoretical concept, further reading and studying that was unnecessary.	*	*The notes was less important because what was written on the notes was something that we already saw and what was already explained to us* (17)
Non-contributive: Iterative cycle 4	Insufficient time to read and study the notes.	**	*I didn't learn much from the notes because we, the lecturer gave it to us yesterday and then I couldn't have enough time to go through them* (22)
	Disregarding notes as a valuable resource.	***	*Notes did not really help me much because I did not really read them* (25)

Although the semiotic tool contributed 27% (Figure 7.94) to the perceived effect that the Ideational Modal Agency had on the participants, only eight of the 25 quotes (32%) indicated that this tool contributed to their semiotic transference process (Figure 7.95).

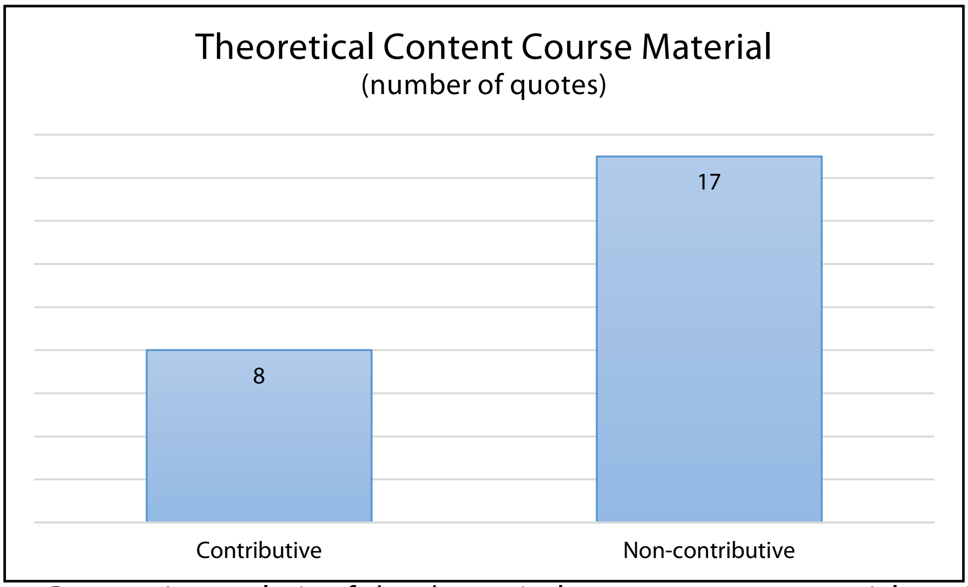


Figure 7.95: Perspective analysis of the theoretical content course material semiotic tool (Cycle 4)

The theoretical content course material semiotic tool contributed minimally to the semiotic transference process, due to the physical barriers and the language and reading skills that the participants experienced. The success of this tool relies on its integration with the other three main modal agencies, accentuated by participant 18's quote:

> *From yesterday's outing in Green Point Park, what helped me the most were the examples in nature, my study buddy and the notes that we were given* (18).

b) Verbal presentation

The influence of the verbal presentation semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.49).

Table 7.49: Contribution of the verbal presentation semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[87]: Recurring contributions from iterative cycles 1, 2 and 3.	Facilitated the semiotic transference process between the theoretical concept and the sign by the introduction of visual and practical activities and examples during the verbal presentation.	***	*The lecturer was, I remember he was teaching us about drinking fountains. The drinking fountains and showing us where the dog can also use the drinking fountain and where the water is going after we have drank it* (10)
	Verbally facilitated the semiotic transference process between the theoretical concept (notes) and the sign, reducing the physical barriers, language and reading skills.	****	*So yesterday, I relied to the lecture for most of the time, because he was the one who was explaining all those things to us* (8)

[87] There were no additional contributive contributions from iterative cycle 4.

			As you see here, lecturer helped me because he explained for us about scale and proportion (20)
	Encouraged active participation in their own learning process.		
	The intervention sustained semiotic transference by becoming a reflective and prompting resource, assisting the recollection of the theoretical concepts.		
Non-contributive[88]: Recurring from iterative cycle 1, 2 and 3.	The semiotic transference through verbal presentation required that the participant had to be physically present.		
	The language barriers were intensified by the verbal intervention.	*	*I did not really, which I did not really understand while they were said to us* (25)

The verbal presentation semiotic tool had the lowest contribution (9%) (Figure 7.94) to the perceived effect that the Ideational Modal Agency had on the participants; however, seven of the eight participants indicated that this tool contributed to their semiotic transference process (Figure 7.96).

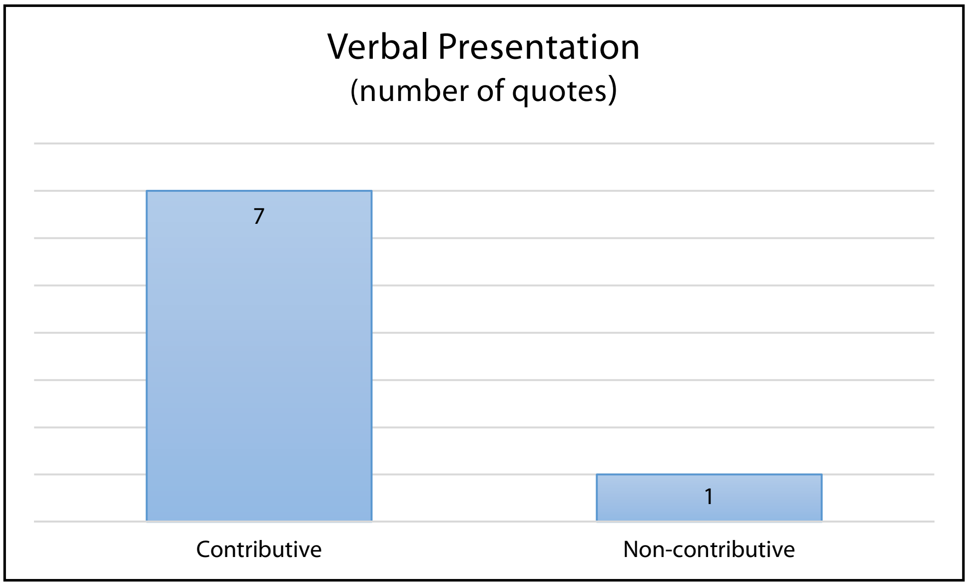


Figure 7.96: Contribution of the verbal presentation semiotic tool (Cycle 4)

The verbal presentation semiotic tool contributed to the semiotic transference process by facilitating the establishment of verbal links between the theoretical concepts and the signs, and through the collaborative knowledge transfer process mediating the verbal and language challenges the participants experienced. The semiotic process can be further enhanced by encouraging the participants to verbally engage with their own learning process.

[88] There were no additional non-contributive contributions from iterative cycle 4.

c) Direct presentation

The influence of the direct presentation semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.50).

Table 7.50: Contribution of the direct presentation semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[89]: Recurring contributions from iterative cycles 1, 2 and 3.	The practical/physical implementation of step 2 in the Design Knowledge Semiotic Process (Figure 6.2) facilitated the conceptualisation process between the theoretical concept and a context specific icon and created a resource of context specific information. For example, in participant 23's quote, the participant was able to use the context specific environment as the resource for the conceptualisation process: *The trees were like in the landscape.*	**** **** **** **** ***	*Because while we were doing the principles of designing proportions* [theoretical concept] *they showed us like this is an example so you get an idea of, okay this is what I'm learning about. <u>You understand it more better and it stays in your mind</u>* (1) *The trees were like in the landscape* [context]. *There was no, almost like no buildings around it so it was just like a field with, I think, five. So that, it creates emphasis trees* [context specific icon]. *<u>You must see it standing anywhere that's why it helped me a lot</u>* (23) [The introduction assignment] *The steps helped us to understand, yeah because we can, like the mountain was big so we can draw a big triangle. Then the gate was smaller. We can do a square there, then the person, circle. Then another circle there so it was helpful* (group interview)
	The outdoor natural environment provided authentic context specific visual resources to become the representamen for the contextualisation process; grounding the contextualisation process firmly into a domain specific context.	**** **** **	*So I marked this one as like the most that helped me because it's <u>examples in nature</u>* (1) *There were so many examples in nature which represents the proportion, scale. Ja. Then like the example of the cars, walkway.* (22)
	The domain specific environment becomes the primary reflective resource, both for the student and the lecturer, explicitly linking the natural environment to the domain of Landscape Architecture.	**** **	*We were doing the scale drawings of the gates and the mountain and the benches. It helped me a lot to understand how does a human lead to the scale and how do <u>landscape architects</u> help, like do their drawings and the structures like from a human scale* (17)
	The outdoor natural environment, previously seen in iterative cycle 2 as an irrelevant teaching and learning environment, became an important platform to understand the theoretical concepts.	**** **** *	*As for the nature, <u>I saw the things and then I understood it from seeing it live</u>* (17) *Example in nature, what helped me was the trees. Going from big – from small to big. That was my scale proportion* (23) *Examples in nature. Ja, examples in nature helped me because I remember there was, I think the – okay what I can recall by examples in nature. There was a, tall buildings and a small building in between those tall buildings. And there was a walkway. That created emphasis, that tall building with the small buildings in between* (24)

[89] There were no additional contributive contributions from iterative cycle 4.

Non-contributive[90]: Recurring from iterative cycle 1, 2 and 3.	Unable to comprehend the relevancy of nature (specific context) in the learning process.		
	Nature as a teaching and learning environment created a sense of confusion and not knowing what to expect.		
	Moving from a traditional classroom environment, which is safe and private, to an outdoor natural environment, exposed to natural elements and social interaction, created a sense of social exposure.		
	The outdoor natural learning environment also challenged them physically and exposed them to natural elements.		
	The visual link between the theoretical concept and the context specific icon was not strong enough to facilitate complete recollection of the theoretical concept.	*	*So it did not help me a lot to see the depth in things and scale and proportion. So it did not help me that much* (16)

The analysis of quotes relating to the contribution of the direct presentation semiotic tool, Figure 7.94, indicated a 49% contribution to the semiotic contextualisation process and 45 of the 46 quotes indicated a positive contribution (Figure 7.97).

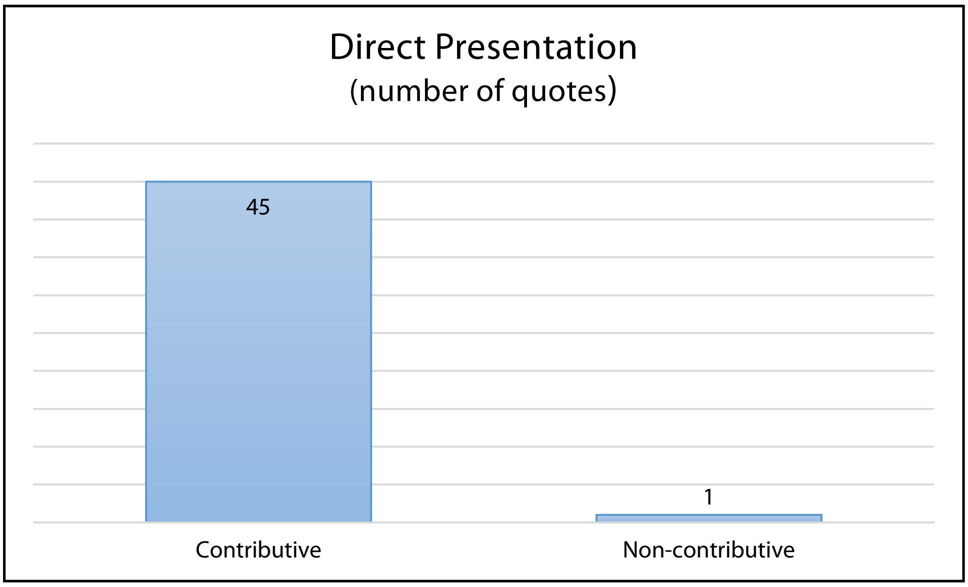


Figure 7.97: Contribution of the direct presentation semiotic tool (Cycle 4)

The direct presentation semiotic tool contributed to the semiotic transference process by supporting the semiotic contextualisation of the theoretical concept into a domain specific icon grounding the contextualisation process firmly into a domain specific context.

[90] There were no additional non-contributive contributions from iterative cycle 4.

d) Indirect representation

The influence of the indirect representation semiotic tool on the semiotic de-contextualisation process was classified as either contributive or non-contributive (Table 7.35).

Table 7.51: Contribution of the indirect representation semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[91]: Recurring contributions from iterative cycles 1, 2 and 3.	Created both visual and cognitive links between the theoretical concept and a direct abstract symbol.		
	Semiotic transference between the theoretical concept and the immediate[92] object (Figure 6.2) was effective enough so that the participants could remember the direct symbol and de-contextualise it into an abstract symbol.	****	[Preparatory Assignment] *I think that video showed something like there was a bad guy. So like that bad guy had like a big, a bigger fist than the body. So, like to reduce the, if you were like to, the bigger guy to make it look like a really, really bad guy, so like you have to like shrink the, his face so that he looked more bad* (8)
	Semiotic transference was enhanced through the co-implementation of the other interventions, indicating the positive contribution the intervention had on the interpretation process.	******	*The examples in nature, like the buildings which showed emphasis. Ja, they helped me more and more with the physical poses* [abstract symbol] (9)
	Encouraged the participants to reflect on their own semiotic transference processes; highlighted the importance of the participants' self-perceptions of their own creative competency.		
	Stimulated creative expression and self-confidence.		
	Inspired creative exploration by making them aware that they can de-contextualise a context specific icon and identify, on their own, an indirect representation of that theoretical concept, even extending that into other contexts.	****	*And then when we were drawing the powerhouse it showed me depth and also the focal point because the powerhouse was far so we had to draw like from, we had to draw what we were seeing and like create depth on it* (17)
Non-contributive[93]: Recurring from iterative cycles 1, 2 and 3.	Underdeveloped ability to create a visual and cognitive link between the theoretical concept and an abstract symbol, and then de-contextualise it into an abstract indirect representation.		
	Struggled to comprehend the relevancy of nature (specific context) in the learning process.		

The indirect representation semiotic tool only contributed 15% (Figure 7.94) to the perceived effect that the Ideational Modal Agency had on the participants, but almost all (88%) the

[91] There were no additional contributive contributions from iterative cycle 4.
[92] The transferred mental representation of the object/theoretical concept.
[93] There were no non-contributive contributions from iterative cycle 4.

participants indicated that this tool did contribute to their semiotic transference process (Figure 7.98).

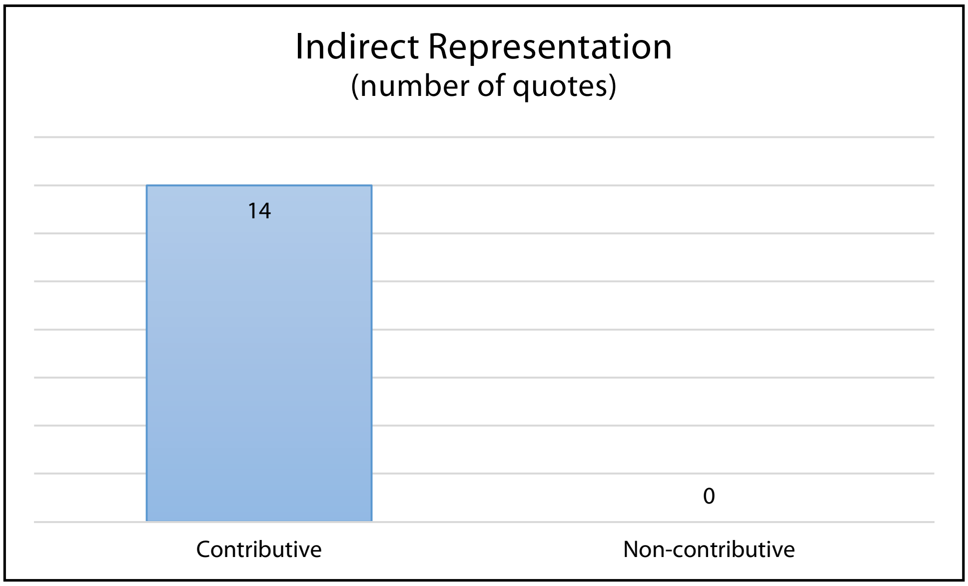


Figure 7.98: Contribution of the indirect representation semiotic tool (Cycle 4)

The indirect representation semiotic tool contributed to the semiotic transference process by supporting the semiotic de-contextualisation of the direct symbol into an abstract symbol[94].

7.7.3.2. Sensory Modal Agency

The Sensory Modal Agency consisted of the following semiotic tools:

- Natural iconic presentation
- Kinesthetic drawing
- Kinesthetic expression

Figure 7.99 indicates the percentage of quotes that relates to each participant's perspective on the influence each modal agency had on his/her semiotic transference process.

[94] Step 4 of the modal agency meaning making process.

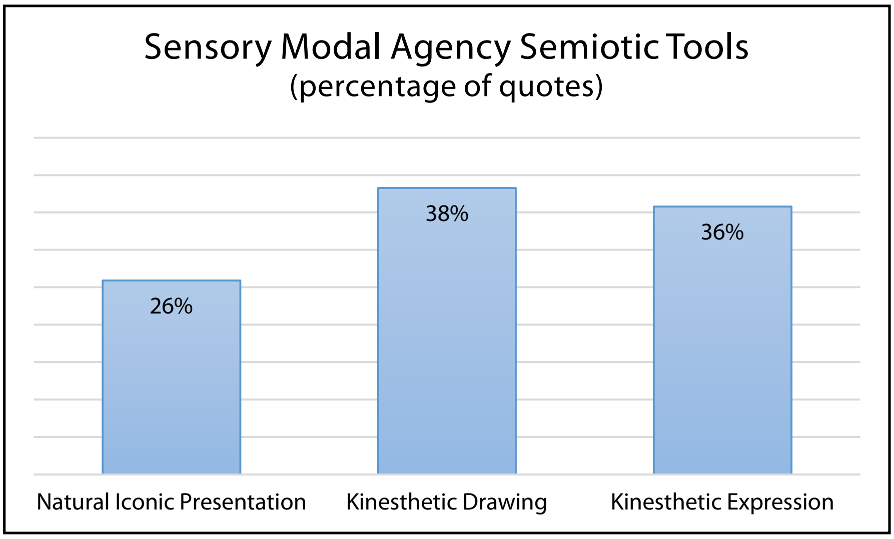


Figure 7.99: Sensory Modal Agency Semiotic Tools Perspective Analysis (Cycle 4)

a) Natural iconic presentation

The influence of the natural iconic presentation semiotic tool on the semiotic transference process was classified as either contributive or non-contributive; however, there were only contributive quotes for this tool (Table 7.52).

Table 7.52: Contribution of the natural iconic presentation semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[95]: Recurring contributions from iterative cycles 1, 2 and 3.	The outdoor natural environment provided authentic context specific visual resources to become the natural iconic[96] examples for the contextualisation process; grounding the contextualisation process firmly into a domain specific context.	**** ***	*The examples in nature, like the buildings which showed emphasis. Ja, they helped me more* (9); *the most that helped me because it's examples in nature* (1) *There was a, tall buildings and a small building in between those tall buildings. And there was a walkway. That created emphasis, that tall building with the small buildings in between* (24)
	Encouraged the use of the natural environment as a resource of inspiration.	**	*Example in nature, what helped me was the trees. Going from big – from small too big. That was my scale proportion* (23)
	The natural environment was used as symbol that represented the emotional challenges some of the participants faced during the design process.		
	The intervention assisted in the recollection process and created external visual prompts to the theoretical concepts.	****	*I remember this other one; there was a powerhouse that we saw there. It showed that from where we were standing because we were at a distance and then the powerhouse was much, like far from us and it created depth* (17)

[95] There were no additional contributive contributions from iterative cycle 4.
[96] Iconic refers to the resemblance or imitation of the object (theoretical concept) by looking exactly like it (i.e. photograph) in nature.

	The physical and natural environment is a domain specific platform that affords identifiable (both for the lecturer and student) and shared exemplars for theoretical representamen.	***	*Now coming to class, now what helped me a lot is to remember all those things that I did outside of the class and the day before. So I remembered the poses that we did, you know, to illustrate our - and to show the authority and the perspective* (14)
	The outdoor natural environment, previously seen in iterative cycle 2 as an irrelevant teaching and learning environment, became an important platform to understand the theoretical concepts and supported the semiotic contextualisation process.	*****	*We learn a lot of things on the site, more than class. On the site, I learn about proportion and scale and then proportion and scale and we were also shown how to calculate. So the mountain, the gates and so on* (10)
Non-contributive[97]: Recurring from iterative cycles 1, 2 and 3.	Nature was seen as not a valid resource of information.		

The natural iconic presentation semiotic tool contributed 26% (Figure 7.99) to the perceived effect that the Sensory Modal Agency had on the participants; all the participants indicated that this tool contributed to their semiotic transference process (Figure 7.100).

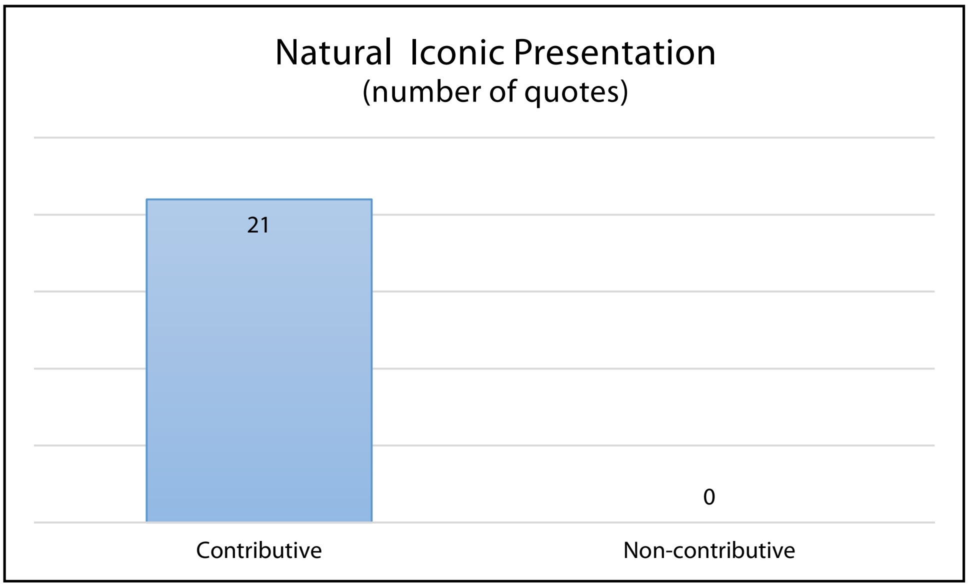


Figure 7.100: Contribution of the natural iconic presentation semiotic tool (Cycle 4)

The natural iconic presentation semiotic tool contributed to the semiotic transference process by providing a practical context specific platform for physical and natural resources in the creation of natural iconic examples.

[97] There were no non-contributive contributions from iterative cycle 4.

b) Kinesthetic drawing

The influence of the kinesthetic drawing semiotic tool on the semiotic de-contextualisation process, as applied in conjunction with the indirect representation semiotic tool, was classified as either contributive or non-contributive (Table 7.53).

Table 7.53: Contribution of the kinesthetic drawing semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[98]: Recurring contributions from iterative cycles 1, 2 and 3.	Created physical and context specific visual links between the theoretical concept and sign.	********	*The drawings, and whenever like we were, something was explained we were asked to draw it and <u>the drawings helped me to understand more</u>* (9) *We were doing the scale drawings of the gates and the mountain and the benches. <u>It helped me a lot to understand how does a human lead to the scale</u>* (17)
	Created the environment where the participants were encouraged to actively participate in the interpretation process.	******	*And also the physical activities that we were doing. <u>We had to lie down and measure ourselves.</u> And also we had to measure ourselves from, like from the – we had to measure ourselves from whatever that was in, like next to us and then it helped me understand scale also* (17) *And the other thing also we had to do, we had to measure a lamppost and lie on the ground to show the scale, how big is it really* (23)
	Facilitated collaborative learning activities through the interaction between their physical bodies, conceptual environment and physical/natural environment.	*******	*And if you actually do it like as in physical form* (2) *<u>I was actually part of it</u> because we did the measurements one to one scale and then we had to reduce it to a certain scale. So it showed me how scale worked. It showed me the proportion* (14)
	Created the environment that supported development of self-perceptions regarding creative competency.	**	*The drawings helped me a lot because I love drawing and in the notes there was place for us to draw and that helped me a lot because <u>we can see the things and draw it down so we can remember it</u>* (23)
	The practical implementation of the semiotic transference process, during this intervention, created opportunities for the participant to reflect, assess and correct their interpretation of a theoretical concept.	*****	*The drawings. Ja, oh, the drawings helped a lot hey because now <u>you get to put what you've learned into a paper and actually see whether you understand it in your own way when you're drawing it</u>. So it helped when we were drawing the examples and the examples of perspective and all that stuff* (1)
Non-contributive[99]: Recurring from iterative cycles 1, 2 and 3.	Struggled to comprehend the relevancy of drawing activities in the learning process.	***	*The drawings were not that helpful because it's something that I, it's more like <u>I was copying something</u> because I saw something and then I had to draw it. It was not that helpful because I already have a picture in mind* (14)

[98] There were no additional contributive contributions from iterative cycle 4.
[99] There were no additional non-contributive contributions from iterative cycle 4.

The kinesthetic drawing semiotic tool contributed 38% (Figure 7.99) to the perceived effect that the Sensory Modal Agency had on the participants; 90% of the quotes indicated that this tool contributed to their semiotic transference process (Figure 7.101).

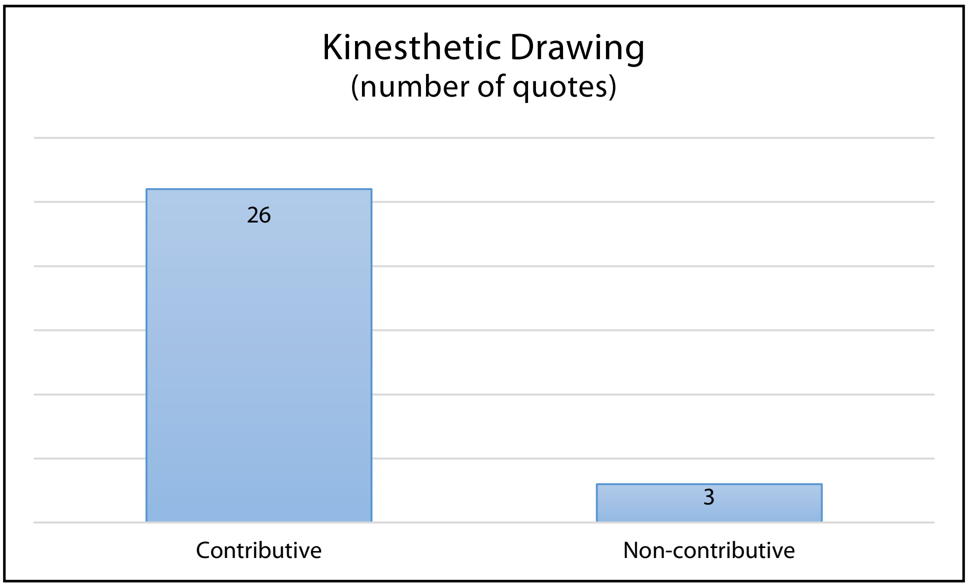


Figure 7.101: Contribution of the kinesthetic drawing semiotic tool (Cycle 4)

The kinesthetic drawing semiotic tool facilitated the semiotic de-contextualisation process through the creation of physical and practical visual links, encouraged active participation in the interpretation process and facilitated learning through the interaction between their physical bodies, conceptual environment and physical/natural environment.

c) Kinesthetic expression

The influence of the kinesthetic expression semiotic tool on the semiotic de-contextualisation process, as applied in conjunction with both the indirect representation (7.7.3.1.d) and emotional group-work (7.7.3.4.a) semiotic tools, was classified as either contributive or non-contributive (Table 7.54).

Table 7.54: Contribution of the kinesthetic expression semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[100]: Recurring contributions from iterative cycles 1, 2 and 3.	The physical/kinesthetic implementation of steps 4 and 5 in the modal agency meaning making process (Figure 6.3) facilitated the de-conceptualisation process from the Direct Symbol to the Abstract Symbol and Interpretation.	*****	*So, ja it helped me a lot because demonstrations are easier to understand, you know* (2)
	The physical/kinesthetic implementation of steps 4 and 5 in the Design Knowledge Semiotic Process supported the recollection of	*********	*So the poses that we did really helped me. Then remembering, ja from yesterday's outing I remember we were shown a pedestrian from where we were standing*

[100] There were no additional contributive contributions from iterative cycle 4.

	theoretical concepts: *shows the perspective* (6); by referring back to the physical activities: *the poses that we did* (6).		*the arrow's bigger then as we look forward it was getting smaller and smaller which shows the perspective* (6) *Now coming to class, now what helped me a lot is to remember all those things that I did outside of the class and the day before. So I remembered the poses that we did, you know, to illustrate our - and to show the authority and the perspective* (14)
	Encouraged active participation in the interpretation process and enhanced their understanding of the theoretical concepts.	***	*And the big group, we were divided into a group of six and like we will do poses and that helped me to understand more and it was like more exciting. So like it was clear to understand* (9)
	Created a safe supportive environment for creative expression and experimentation.		
	Enhanced an individual's self-efficacy and creative self-confidence to be more willing to participate.	**	*What helped me outside the class was the physical activities. We had to do some poses to make, to show authority. And doing those poses, it helped me a lot because I used that thing I did it yesterday to doing my design principles* (23)
	The co-implementation of the other interventions not only facilitated the semiotic transference process, but also strengthened some of the weaker semiotic links created by other interventions.	***** *	*And the group-work, like I said the physical activities helped a lot as well and my study buddy is really positive and really helping me* (21)
	Encouraged the whole class to participate and be actively involved in the teaching and learning activities.	**	*Then outside, yesterday, with yesterday's activity, physical activities, poses they go together because the physical activities and the group-work, the big group-work we did them together* (6)
Non-contributive[101]: Recurring from iterative cycles 1, 2 and 3.	Resistance to physical activities	*	*We didn't do much of physical work so it did not help me much* (18)
	The perception that physical activities could be seen as playing.		
	Struggled to comprehend the relevancy of physical activities in the learning process.	*	*The physical activities, it didn't help me because I did not understand why we are doing physical yesterday* (22)

The kinesthetic expression semiotic tool contributed 36% (Figure 7.99) to the perceived effect that the Sensory Modal Agency had on the participants; 26 of the 28 quotes (93%) indicated that this tool contributed to their semiotic transference process (Figure 7.102).

[101] There were no additional non-contributive contributions from iterative cycle 4.

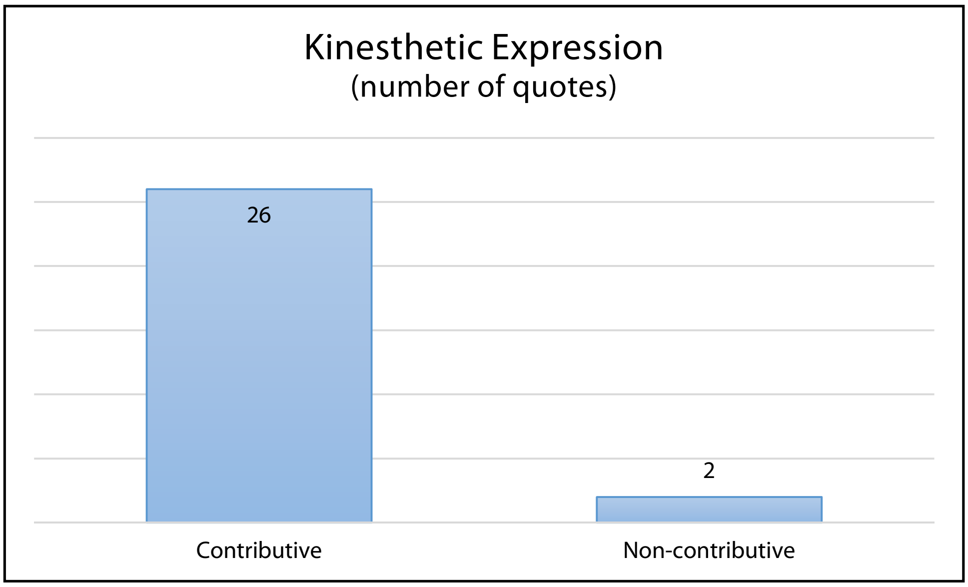


Figure 7.102: Contribution of the kinesthetic expression semiotic tool (Cycle 4)

The kinesthetic expression semiotic tool facilitated the semiotic de-contextualisation process through the physical activities, encouraged active participation in the interpretation process, stimulated creative exploration, enhanced the recollection of theoretical concepts and supported the semiotic transference process through the co-implementation of modal agencies.

7.7.3.3. Logical Modal Agency

The Logical Modal Agency consisted of the following semiotic tools:

- Logical iconic presentation
- Logical symbolic representation
- Logical interpretation.

Figure 7.103 indicates the percentage of quotes that relates to each participant's perspective on the influence each semiotic tool had on his/her semiotic transference process.

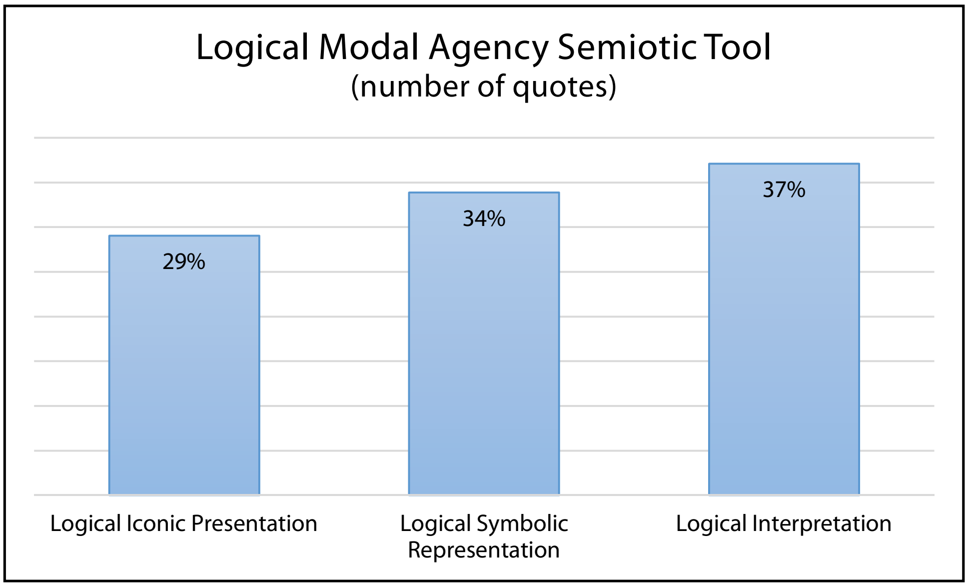


Figure 7.103: Logical Modal Agency Semiotic Tool Perspective Analysis (Cycle 4)

a) Logical iconic presentation

The influence of the logical iconic presentation semiotic tool on the semiotic contextualisation process was classified as either contributive or non-contributive, as applied in conjunction with both the direct presentation (7.7.3.1.c) and the natural iconic presentation (7.7.3.2.a) semiotic tools; however, for this iterative cycle it was only contributive (Table 7.55).

Table 7.55: Contribution of the logical iconic presentation semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[102]: Recurring contributions from iterative cycles 1, 2 and 3.	Repeating this modal intervention through the various theoretical concepts stimulated the visual sensitivity of identifying context specific icons.	****	*And then the drawings. We were asked to draw the benches, the gazebo, lighthouse, the gate and mountains* (10)
	This intervention, in conjunction with both the natural iconic presentation intervention (7.5.3.2.a) and direct presentation intervention (7.3.c), stimulated a spatial ability to visually identify and connect a context specific icon to a theoretical concept.	**** **** **	*Example in nature, what helped me was the trees. Going from big – from small to big* [context specific icon]. *That was my scale proportion* [theoretical concept] (23)
	The practical context specific platform, provided by the natural iconic presentation intervention, created a resource for various context specific direct semiotic links, from basic theoretical concepts like scale to more advanced theoretical concepts like authority and direction.	****	[Basic theoretical concept] *We were doing the <u>scale drawings</u> of the gates and the mountain and the benches* (17); to [Advanced theoretical concept] *And authority. I remember this other one; there was a powerhouse that we saw there. It showed that from where we were standing because we were at a distance and then the powerhouse was much, <u>like far from us and it created depth</u>* [direction] (17)
	Weak semiotic link between the theoretical concept and the context		

[102] There were no additional contributive contributions from iterative cycle 4.

	specific icon, thus difficulty remembering the theoretical concept.		
Non-contributive[103]: Recurring from iterative cycles 1, 2 and 3.	Nature was seen as not a valid resource of information (same as the natural iconic presentation intervention).		
	Low spatial sensitivity to visual signs, unable to link a theoretical concept to a context specific sign.		

This semiotic tool contributed 29% (Figure 7.103) to the perceived effect that the Logical Modal Agency had on the participants. All the participants indicated that this tool contributed to their semiotic transference process (Figure 7.104).

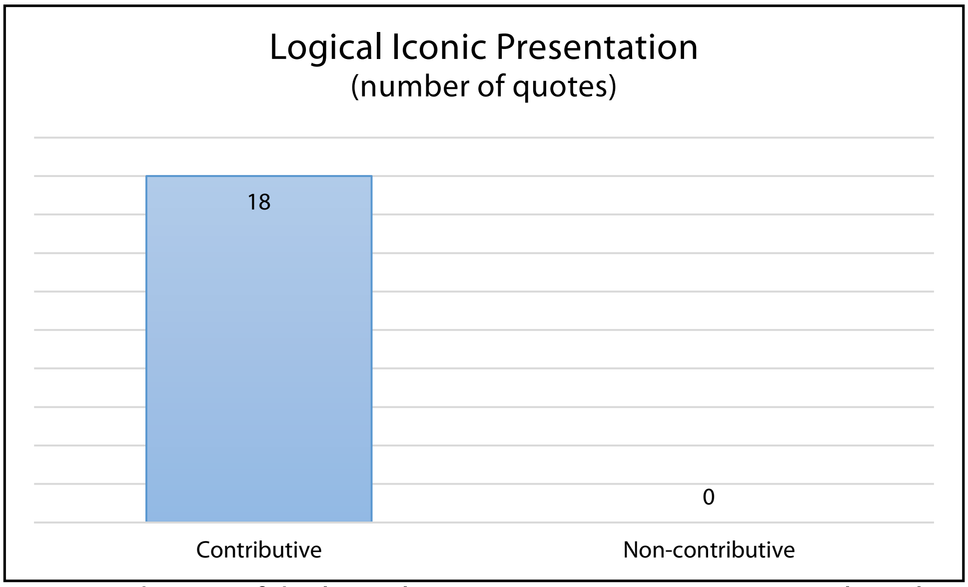


Figure 7.104: Contribution of the logical iconic presentation semiotic tool (Cycle 4)

The logical iconic presentation semiotic tool assisted the semiotic contextualisation process by using the spatial ability to visually identify and connect a context specific icon to a theoretical concept.

b) Logical symbolic representation

The influence of the logical symbolic presentation semiotic tool on the semiotic re-contextualisation process, as applied in conjunction with both the indirect representation (0.d) and logical interpretation (7.6.3.3.c) semiotic tools, was classified as either contributive or non-contributive; however, for this iterative cycle it was only contributive (Table 7.56).

[103] There were no non-contributive contributions from iterative cycle 4.

Table 7.56: Contribution of the logical symbolic representation semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[104]: Recurring contributions from iterative cycles 1, 2 and 3.	Visual and verbal analogies supported the re-contextualisation transference between the Abstract Symbol and the Abstract Interpretation, stimulated the recollection of the theoretical representamen.	******	*Because while we were doing the principles of designing proportions, when we, when they showed us like this is an example [visual analogy] so you get an idea of, okay this is what I'm learning about. You understand it better and it stays in your mind* (1)
	The context specific representamen supported the semiotic transference between step 4: *the sizes of the trees* to step 5: *made me remember of what to do on today's design, on the perspective one*, of the Design Knowledge Semiotic Process (Figure 6.3).	********	*what I remembered yesterday, it was the nature of how the sizes, the sizes of the trees and that's what made me remember of what to do on today's design, on the perspective one* (12)
	Supported the development of the logical ability to understand and apply abstract symbols - being able to create an Abstract Interpretation using geometric shapes.	****	*The steps helped us to understand, yeah because we can, like the mountain was big so we can draw a big triangle. Then the gate was smaller. We can do a square there, then the person, circle. Then another circle there so it was helpful* (group interview)
	Encouraged them to understand and apply abstract symbols in various contexts.	***	*So like that bad guy had like a big, a bigger fist than the body. So, like to reduce the, if you were like to, the bigger guy to make it look like a really, really bad guy, so like you have to like shrink the, his face so that he looked more bad* (9)
Non-contributive[105]: Recurring from iterative cycles 1, 2 and 3.	A logical ineptitude to understand and apply abstract symbols, unable to use geometric shapes to re-contextualise an Abstract Symbol to an Abstract Interpretation.		

This semiotic tool had a contribution of 34% (Figure 7.103) to the perceived effect that the Logical Modal Agency had on the participants; however, all the quotes indicated that this tool contributed to their semiotic transference process (Figure 7.105).

[104] There were no additional contributive contributions from iterative cycle 4.
[105] There were no non-contributive contributions from iterative cycle 4.

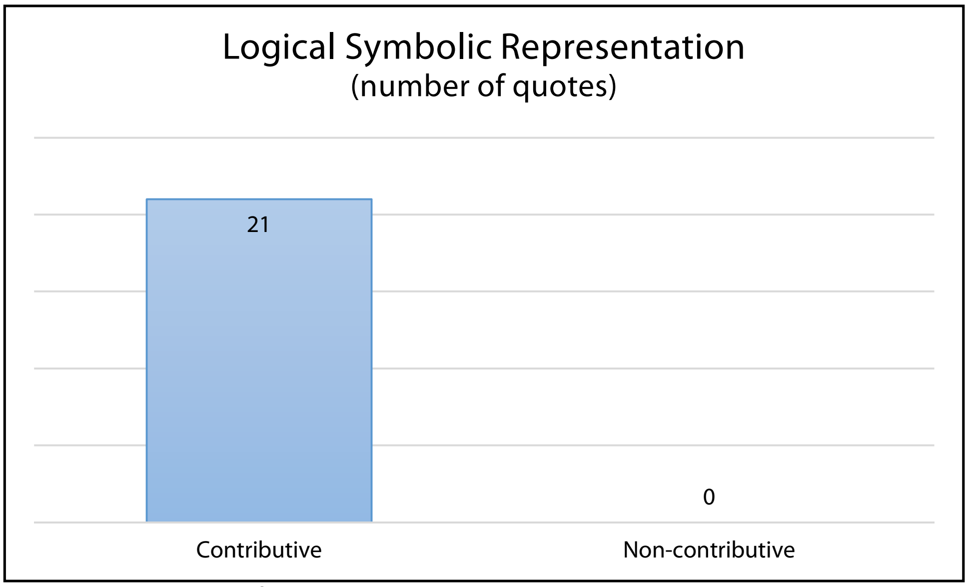


Figure 7.105: Contribution of the logical symbolic semiotic tool (Cycle 4)

The logical symbolic representation semiotic tool assisted the semiotic re-contextualisation by accessing context specific theoretic symbolic representamen to support transference between the Abstract Symbol and Abstract interpretation.

c) Logical interpretation

The influence of the logical interpretation semiotic tool (only implemented during stage 2 of the intervention) on the re-semiotisation and re-contextualisation process was classified as either contributive or non-contributive; however, for this iterative cycle it was only contributive (Table 7.57).

Table 7.57: Contribution of the logical interpretation semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[106]: Recurring contributions from iterative cycles 1, 2 and 3.	Supported the re-contextualising of the context specific theoretic symbolic representamen into an abstract artefact, for example connecting an abstract visual analogy into a domain specific context artefact.	******	*Picture P* (Figure 7.106) *helped me because picture P had the dogs and its puppies and the dog had authority over the puppies. So it also helped me a lot to understand authority* (17)
	The geometric shapes simplified this process, encouraging experimentation for different design solutions and stimulated creative expression.		
	Identifying and using design precedents, incorporating previous ideas into new situations using visual and verbal analogies acted as a resource for inspiration and direction.	*****	*Picture D* (Figure 7.107) *had the lawn and the space from the lawn of the picture, the lawn was going to a certain space. So the distance of the lawn showed depth and also the lawn like was going to a distance* (17)

[106] There were no additional contributive contributions from iterative cycle 4.

	The implementation of both visual and verbal analogies stimulated recollection of existing semiotic transference processes.	**** ***	*There was picture C* (Figure 7.109), *reminded me of authority. And there was a building there which reminded me of authority* (25) *It* [visual and verbal analogies] *was useful because it's not that much different between yesterday and then today. Those posters are representing what was happening yesterday* (22).
	Developed a logical ability to analytically think about what they are seeing: *the word go was written repeatedly*, reflect and then link it to the known theoretical concept: *you are going further… It emphasised the depth.*	***	*And then the words, it was picture 13* (Figure 7.108). *It was stay, go. And then the word go was written repeatedly and then it showed that, oh you are going further. It emphasised the depth* (14)
	Developed a logical ability to create divergent iterations between the theoretical concept, the sign and the Abstract Artefact.		
Non-contributive[107]: Recurring from iterative cycles 1, 2 and 3.	The use of geometric shapes to re-contextualise an Abstract Symbol to an Abstract Interpretation restricted the creative process.		
	Some of the verbal analogies were not clear and were perceived as limiting.		

Figure 7.106: Visual analogy that represents authority, example P. Source: www.purejargon.wordpress.com

This semiotic tool had the highest contribution (37%) (Figure 7.103) to the perceived effect that the Logical Modal Agency had on the participants; all the quotes (100%) indicated that this intervention contributed to their semiotic transference process (Figure 7.110).

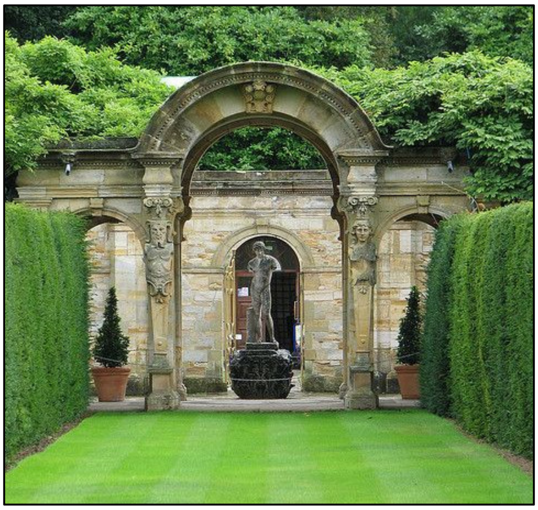


Figure 7.107: Visual analogy that represents perspective , example D. Source: www.agentofstyle.com

[107] There were no non-contributive contributions from iterative cycle 4.

The logical interpretation semiotic tool assisted the re-semiotisation and re-contextualisation process by the development of the logical ability to understand analytically and think divergently about design solutions, also incorporating design precedents into their semiotic transference process.

Figure 7.108: Verbal analogy that represents depth, example 13.
Source: www.mrsandersclass.weebly.com


Figure 7.109: Visual analogy that represents authority, example C.
Source: www.askideas.com

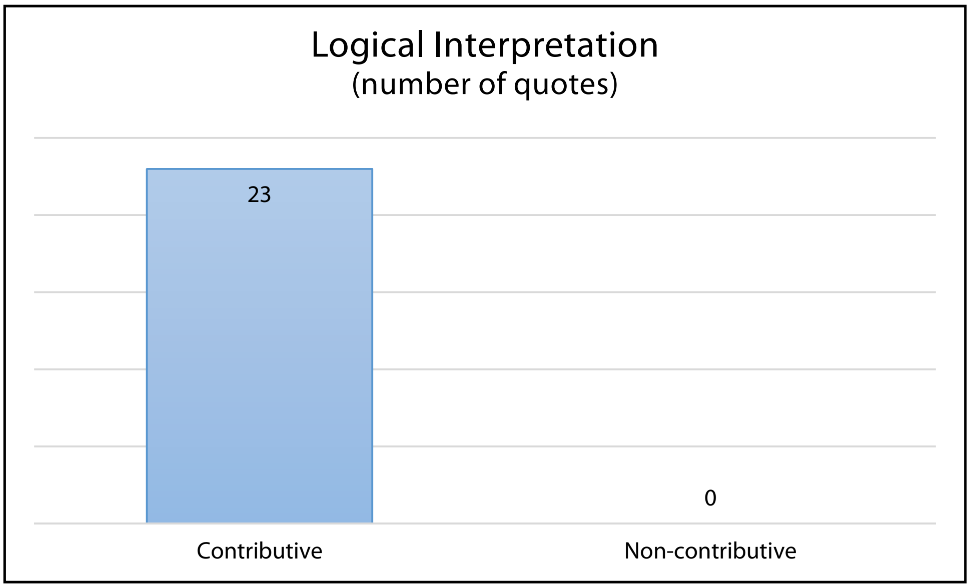


Figure 7.110: Contribution of the logical interpretation semiotic tool (Cycle 4)

7.7.3.4. Emotional Modal Agency

The Emotional Modal Agency consisted of the following semiotic tools:

- Group-Work
- Friends/peers discussion
- Individual reflection
- Self-Study

Figure 7.111 indicated the percentage of quotes that relates to each participant's perspective on the influence each semiotic tool had on his/her semiotic transference process.

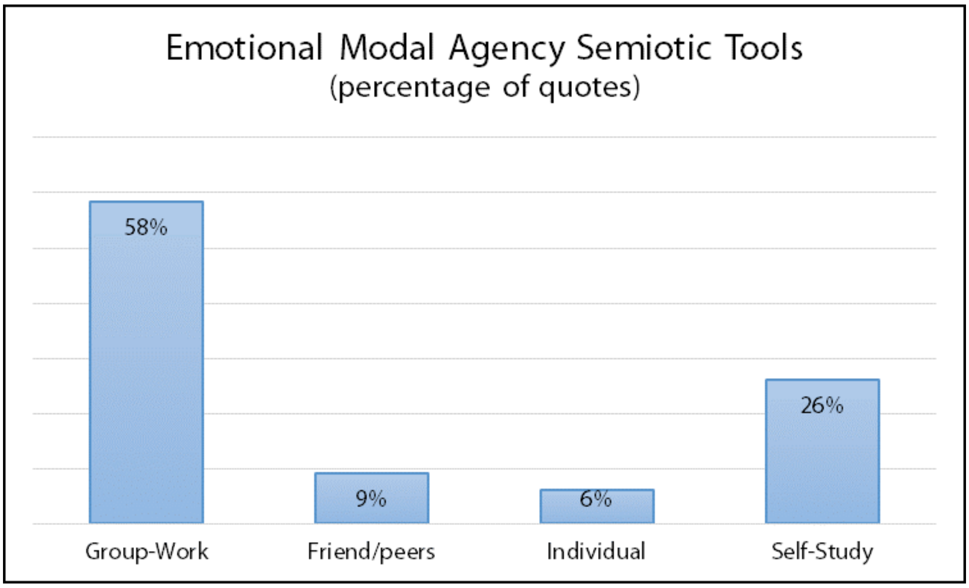


Figure 7.111: Emotional Modal Agency Semiotic Tools Perspective Analysis (Cycle 4)

a) Group-Work

The influence of the group-work semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.58).

Table 7.58: Contribution of the group-work semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[108]: Recurring contributions from iterative cycles 1, 2 and 3.	Created an environment that encouraged collaborative learning, supporting the transference of knowledge and skills.	*********	*And then the big group-work as well helped me <u>because we did tasks together</u> as a group and then <u>we combined ideas and we shared views</u>* (1)
	Facilitated creative interaction between group members.	*****	*The big group-work, it helped me a lot because more minds come together and we work better and <u>more ideas can flow better</u>* (23)
	Collaborative learning created a supportive learning environment, created a sense of belonging.	***	*So my study buddy was very useful and helpful to me because we worked together and if another person is confused the other*

[108] There were no additional contributive contributions from iterative cycle 4.

			one would explain and take the other one through everything (2)
	The large group concept created a bigger resource of knowledge and supported the meaning making process of that knowledge, bridging the language barrier and providing various perspectives on that theoretical concept and reducing misunderstanding.	**** **** ***	*So what helped me the most was the big group-work because <u>we were able to share one another's thoughts</u>* (11) *And the discussions and the working that we were doing as groups helped me also like to understand more about scale and proportion* (17)
	The 'study-buddy' concept, where each participant was co-responsible for another participant, supported the semiotic process by creating a supportive learning environment that provided: additional resources of information, supported the explanation of theoretical concepts (bridging the language barrier), enabled collaborative learning by encouraging active participation and social interactions - thus creating a safe collaborative learning environment.	**** **** *	*Maybe the other person knew something that I didn't know it and then somehow we helped each other…the study buddy, because we were assigned a study buddy so they also helped me in a way* (1) *my study buddy was very useful and helpful to me because we worked together and if another person is confused the other one would explain and take the other one through everything* (2) *when I did not understand something then <u>she would explain it to me and vice versa</u>* (9)
Non-contributive: Recurring from iterative cycles 1, 2 and 3.	A resistance to working in groups.		
	Group members not participating.	***	*And then study buddy, yoh my study buddy yoh. She's something else…didn't necessarily help… If I had gotten another study buddy but my study buddy's too lazy* (11)
	The 'study-buddy' not attending.		
Non-contributive: iterative cycle 4	The theoretical resources of one additional person was limited.	***	And the study buddy, the study buddy, we did the same thing. We didn't really understand what the notes were all about (12)

Accumulative to the contributive influences that emerged from iterative cycles 1, 2 and 3, i.e. contributions of the group-work semiotic tool, in facilitating transference knowledge and also creating a supportive environment for collaborative learning processes, were the contributive influences that the sizes of groups (Figure 7.112), the group-work process model (further referred to as large groups) and 'study-buddy' concepts had on the semiotic transference process.

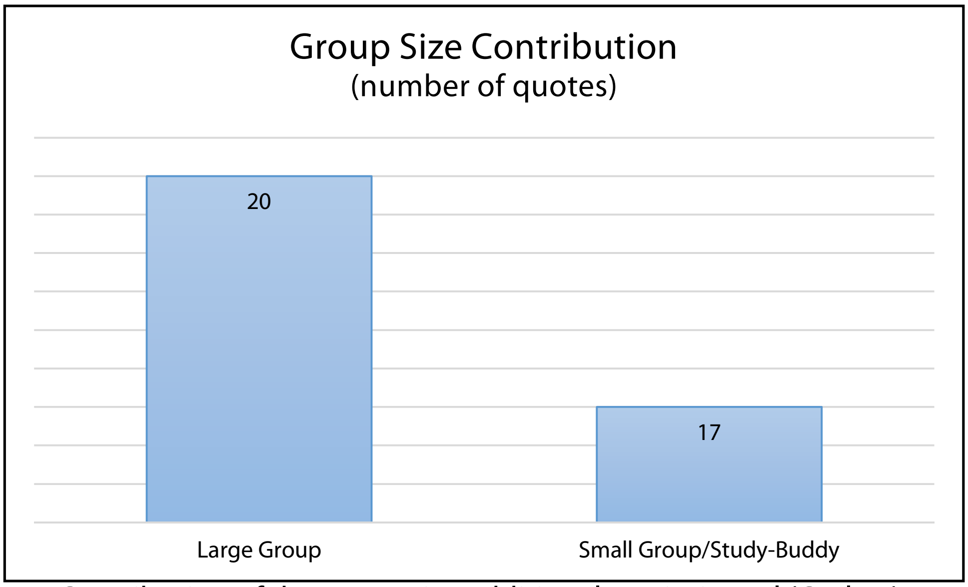


Figure 7.112: Contribution of the group size additional semiotic tool (Cycle 4).

This semiotic tool had the highest contribution (58%) (Figure 7.111) to the perceived effect that the Emotional Modal Agency had on the participants; 31 of the 37 quotes (84%) indicated that this tool contributed to their semiotic transference process (Figure 7.113):

> *And the group-work, like I said the physical activities helped a lot as well and my study buddy is really positive and really helping me* (21).

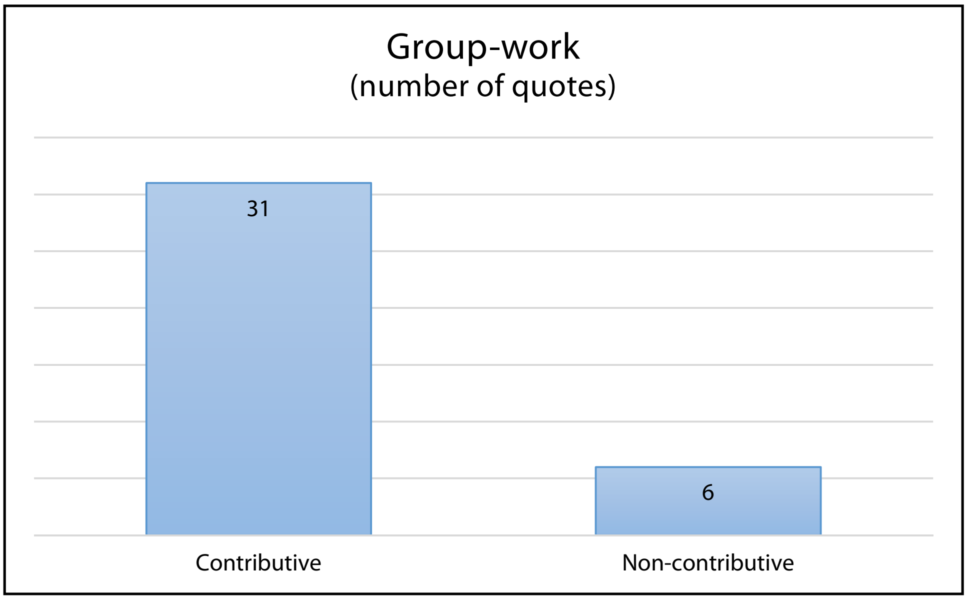


Figure 7.113: Contribution of the group-work semiotic tool (Cycle 4).

The group-work semiotic tool acted as a facilitation agent that assisted the semiotic processes of theoretical concepts by facilitating knowledge transference activities and created a supportive environment for collaborative learning processes.

b) Friends/peers discussion

The influence of the friends/peers discussion semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.59).

Table 7.59: Contribution of the friends/peers discussion semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[109]: recurring contributions from iterative cycles 1, 2 and 3.	The verbal resources of 'others' supported semiotic transference between the theoretical concept and the sign.	**	*And also my friends and peers helped me to understand scale and proportion more and how to do like a perspective drawing and how to show authority* (17)
	Encouraged collaborative learning through the creation of a supportive social environment.	**	*Oh, so my friends and the peers, they kept explaining how scale and proportion works. So they helped me to understand more of how scale works, and how human scale helps to create something in proportion* (18)
	Assisted the absent participants' semiotic transference by providing theoretical resources.		
	Facilitated collaborative learning by extending the learning process into a social environment.		
	Sustained the semiotic transference by assisting recollection.		
	Instigating active interaction with the meaning making process.		
Non-contributive[110]: recurring from iterative cycles 1, 2 and 3.	Insufficient information from friends.	**	*I didn't learn much from friends* (10)
	Friends could not successfully explain the theoretical concepts.		

This semiotic tool had the second lowest contribution of 9% (Figure 7.111) to the perceived effect that the Emotional Modal Agency had on the participants. Only four of the six quotes (67%) indicated that this tool contributed to their semiotic transference process (Figure 7.114).

[109] There were no additional contributions from iterative cycle 4.
[110] There were no additional non-contributions from iterative cycle 4.

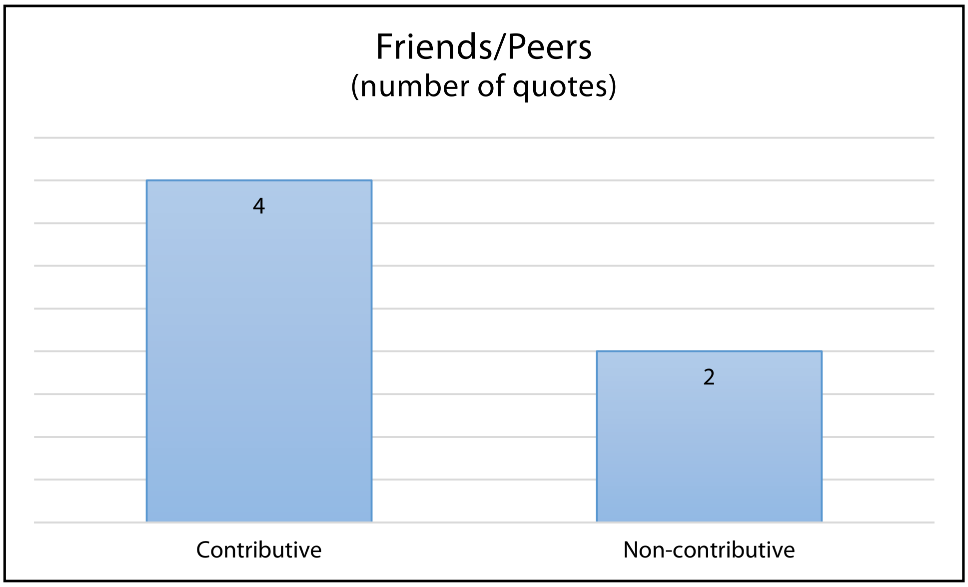


Figure 7.114: Contribution of the friends/peers discussion semiotic tool (Cycle 4).

The friends/peers discussion semiotic tool minimally contributed as a facilitation agent that assisted the semiotic processes of theoretical concepts by providing the resources of 'others', facilitated extended and collaborative learning.

c) Individual reflection

The influence of the individual reflection semiotic tool on the semiotic transference process was classified as either contributive or non-contributive; however, for this iterative cycle it was only contributive (Table 7.60).

Table 7.60: Contribution of the individual reflection semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive[111]: recurring contributions from iterative cycles 1, 2 and 3.	Encouraged individuals to actively participate in their own learning process and to use their own personal knowledge they had on the theoretical concept to facilitate the semiotic transference process.	****	*There was individual work where we had to, we were drawing. I was explaining to myself things on how can I put something in my words in order to understand better* (25) *Individual work shows that I understood some of the work* (24)
	Created an opportunity for individuals who prefer working alone to actively participate in their own learning process.		
Non-contributive[112]: recurring from iterative cycles 1, 2 and 3.	Working individually was perceived to limit creativity and non-contributive to the semiotic transference process.		
	Failure to comprehend the relevancy of nature (specific context) the same as the natural iconic intervention; both of them was implemented during the same activity.		
	A low sense of self-efficacy, the individuals' self-perceptions of their		

[111] There were no additional contributions from iterative cycle 4.
[112] There were no non-contributions from iterative cycle 4.

	own creative competency, discouraged them to individualise their own learning process.		

This semiotic tool had the lowest perceived effect (6%) (Figure 7.111) on the contribution that the Emotional Modal Agency had on the participants. However, all the quotes indicated that this tool contributed to their semiotic transference process (Figure 7.82).

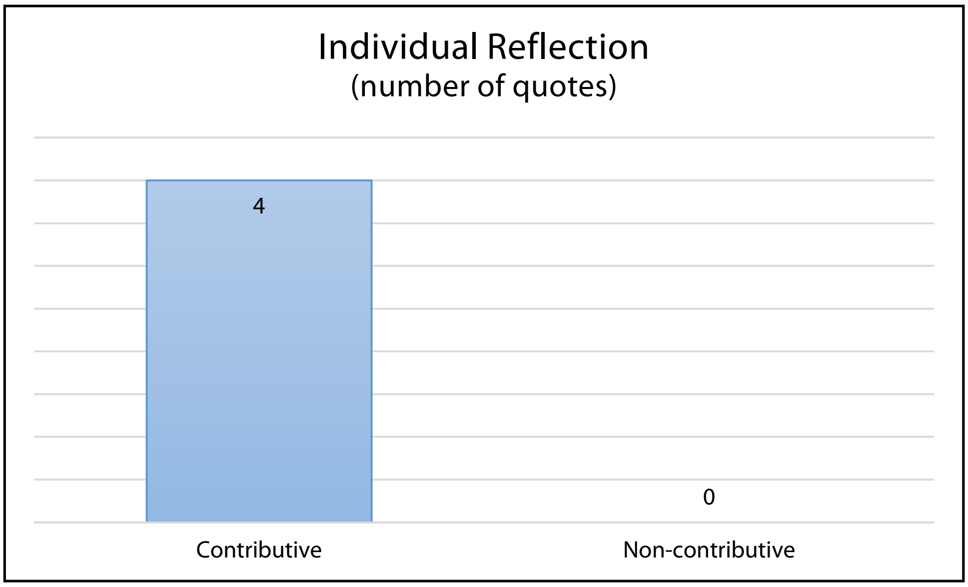


Figure 7.115: Contribution of the individual reflection semiotic tool (Cycle 4).

The individual reflection semiotic tool encouraged the reflection of the individuals' existing resources of knowledge and incorporated that to facilitate their own semiotic process.

d) Self-Study

The influence of the self-study semiotic tool on the semiotic transference process was classified as either contributive or non-contributive (Table 7.61)

Table 7.61: Contribution of the self-study semiotic tool (Cycle 4)

Contribution	Influence	FRQ	Illustrative quotes
Contributive: recurring contributions from iterative cycles 1, 2 and 3.	Encouraged and facilitated extended individual learning.	****	*It made <u>me interact with the knowledge</u> that I initially have from the YouTube video* (14).
	The preparatory assignment introduced the theoretical concept and promoted understanding and expectations.	**** ****	*Self-studying also helped there and there, especially the assignment we got before going to Green Point Park* (11) *The work that really helped me is the YouTube video. We were given a link to go and watch this tutorial video and then it made me understand the perspective, the proportion and the scale* (14)
Non-contributive: recurring from iterative cycles 1, 2 and 3.	The theoretical content course material did not support self-study.	*	*I did not – the notes that we were given, I did not study them by myself* (18)
	The English language and reading skills barrier, that some of the participants at CPUT faced, caused reading and	**	*Because we were told to read through the notes and I'm not very good with that. I get distracted* (1)

	understanding the notes to be problematic.		
Non-contributive: Iterative cycle 4	Reluctance to self-study.	***	*I rather do practical's and interact than to just sit by myself and study* (8); and *Self-study. To be honest I didn't even do self-study* (21)

This semiotic tool contributed 26% (Figure 7.111) to the perceived effect that the Emotional Modal Agency had on the participants; ten of the sixteen quotes (63%) indicated that this tool contributed to their semiotic transference process (Figure 7.116).

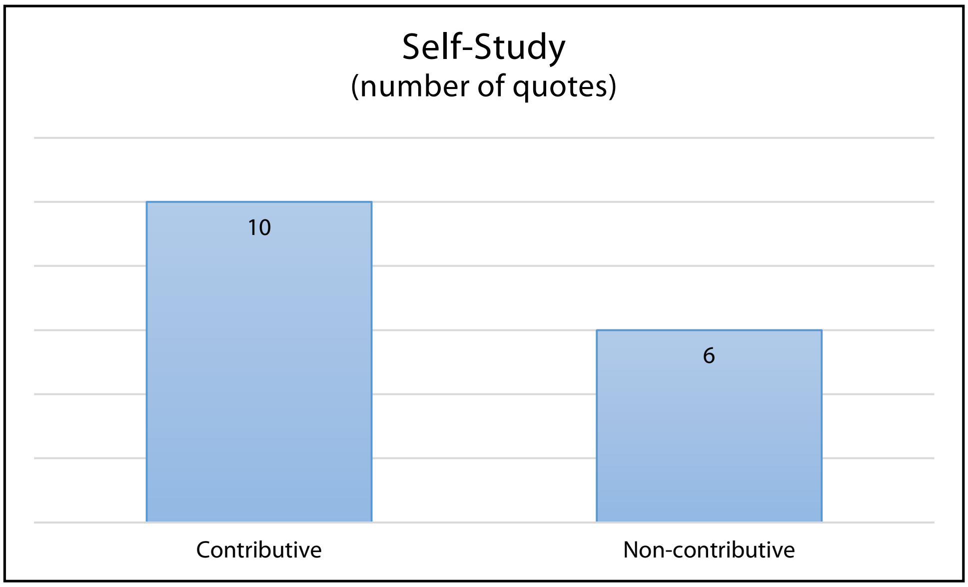


Figure 7.116: Contribution of the self-study semiotic tool (Cycle 4).

The self-study semiotic tool encouraged the individual to become the facilitating agent for his or her own semiotic contextualisation process. The semiotic contextualisation process was further enhanced by the implementation of this semiotic tool before step 1 in the modal agency meaning making process, and encouraged the participants to individually find more resources of the theoretical concepts.

7.7.4 Design assignment overall reflection after iterative cycle 4

The qualitative data on the perceived contribution of all the modal agencies on each of the participants' semiotic transference process were quantified and indicated in Figure 7.117. The bar graph clearly indicates the contributive value variance of each intervention on every single participant. Overlaying that graph with the scores from design assignment 5 (Figure 7.118), indicates a comparison between the perceived contribution the modal agencies had and how it contributed to re-semiotisation and re-contextualisation of a theoretic concept into an abstract artefact.

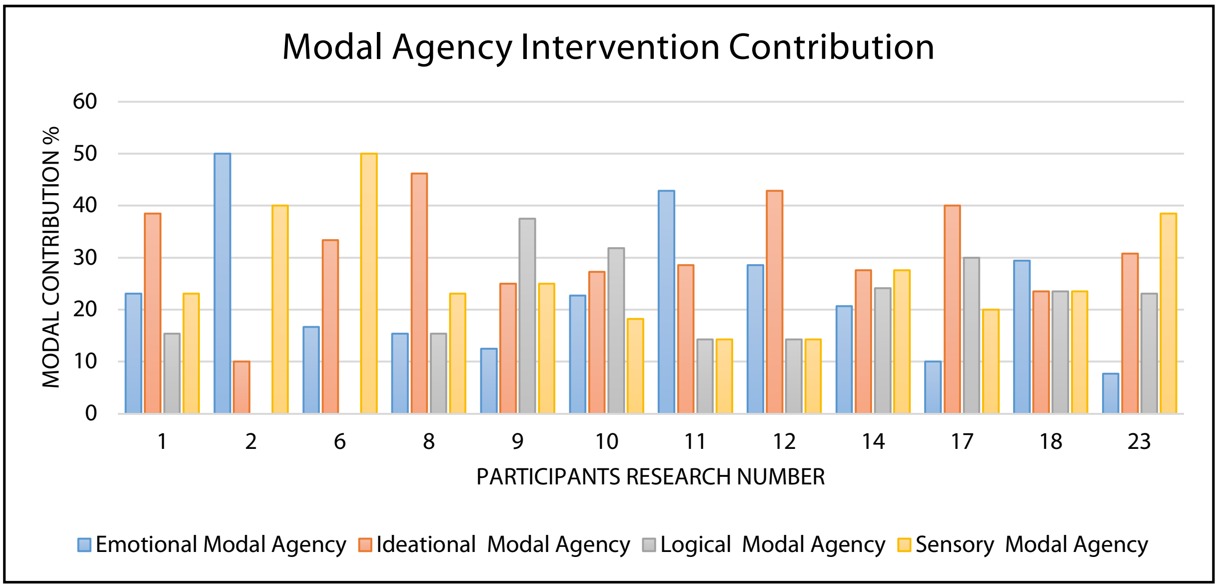


Figure 7.117: Contribution value of the modal agency intervention (Cycle 4)

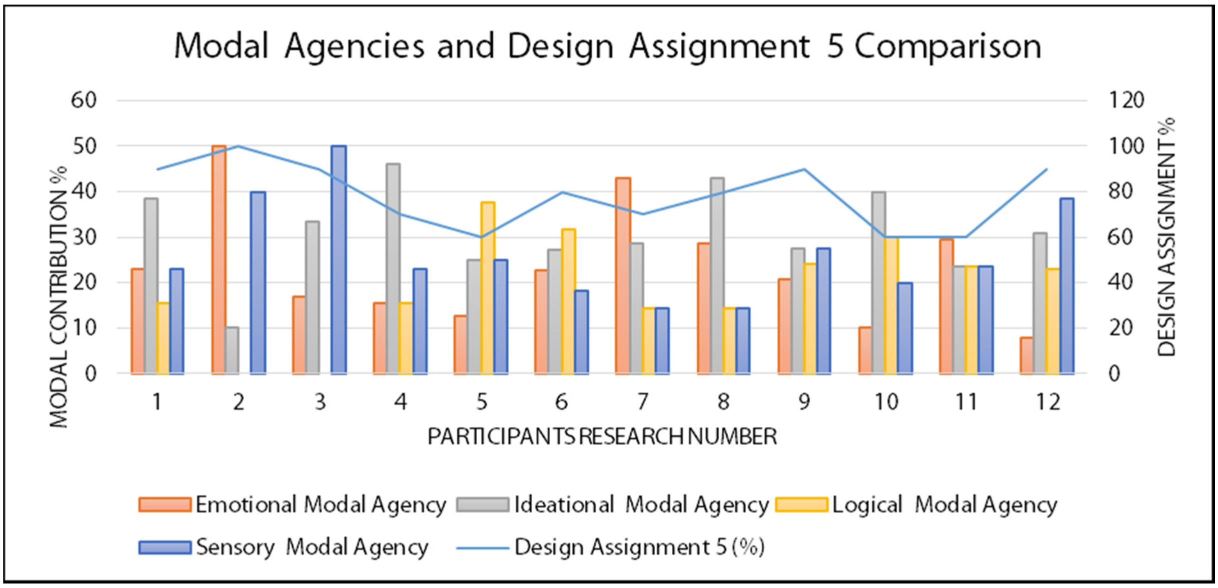


Figure 7.118: Comparison of the modal agencies with design assignment 5 (Cycle 4)

7.8 Conclusion

This chapter represented the implementation and evaluation of the design skill set framework, conceding with the first part of the Phase 3 of the DBR process. The research findings from both the quantitative and qualitative data-collection methods were outlined in this chapter. Overall, the analysis of the data indicated that the design skill set enhancement framework - not only through the implementation of existing principles of teaching and learning in design education, but also through the creation of both the design skill set modal agencies and the design knowledge semiotic process - created an authentic and contextual design teaching and learning environment where the design skill sets were enhanced. The implementation stages, as well as the four iterative cycles of this study, aligned with the iterative characteristic of the DBR process (Table 4.2). The study's mixed research methods concurred with the integrative character of the DBR process, which was used to maximise the credibility of the study as well as highlighting new needs and issues that emerged during the iterative cycles.

In Chapter 8, a retrospective interpretation is done by evaluating the data in more detail - which places the findings within a theoretical framework, representing the latter part of phase 3 of the DBR process.

Chapter 8 :
RETROSPECTIVE INTERPRETATION

8.1 Introduction

Recognising the complex, multilevel, iterative, multivariate and interventionist nature of Design-Based Research studies, Shavelson and others (2015) argue for intensive, iterative investigations that trace the design process and capture meaning constructed by individuals over time, with the intent of improving the effectiveness of instructional tools to support learning. A retrospective interpretation produces a situated, narrative account of learning and how the design process can be structured and supported (Cobb *et al.*, 2003). The narrative account places this study in a broad theoretical context and indicates if and how the design skill set framework enhanced the skill sets of the participants.

Chapter 7 presented the implementation and evaluation of the design skill set framework, coinciding with the first part of Phase 3 of the DBR process. This chapter aims to provide a rigorous in-depth interpretation of the data; more specifically, the data of three randomly selected participants (Figure 3.1), delving deeper into the design skill set heuristics that emanated from the multiple intelligence conjecture-driven teaching experiment. In this interpretation, it is important to keep in mind that the design skill set framework consisted of two components, namely the design knowledge semiotic process (DKSP) and the design skill set modal agencies, aligning the research results of this study with the design process and setting which concur with the contextual characteristics of a DBR process (Table.4.2).

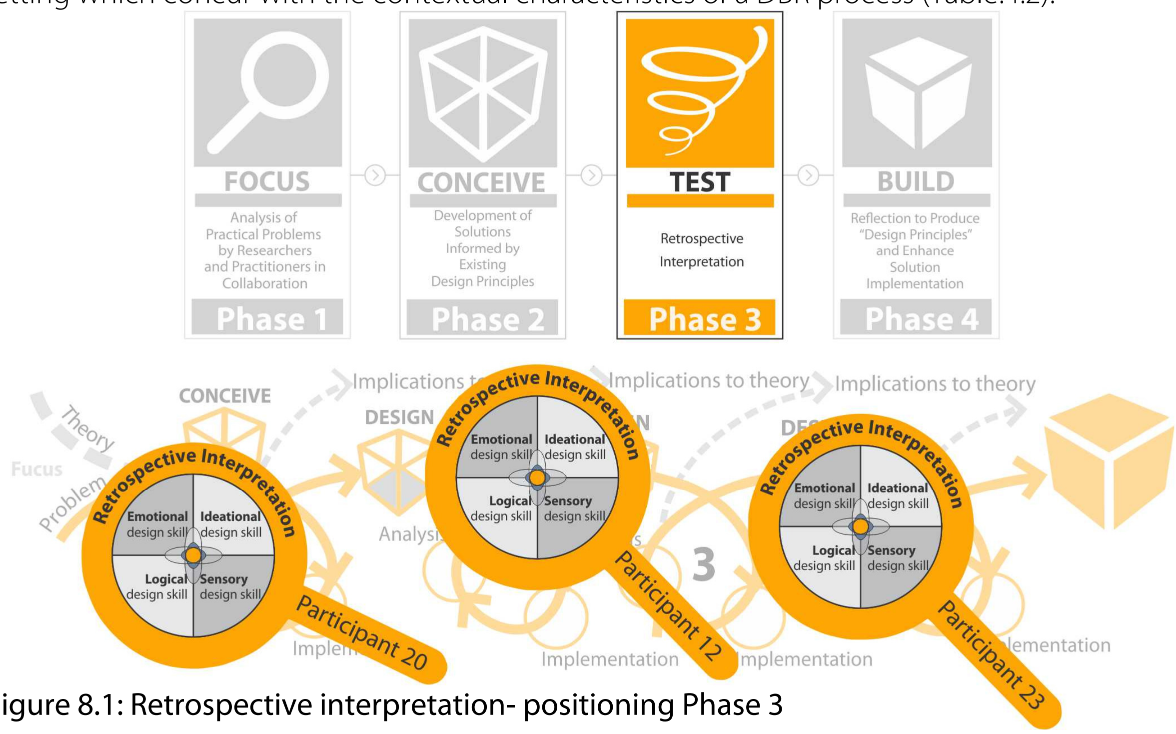


Figure 8.1: Retrospective interpretation- positioning Phase 3

8.2 **Participant selection**

The participant selection was implemented through a stratified sampling method (see section 4.4.2.4). The participants' results of design assignment 1 (Chapter 5) were used to group all the participants into three subgroups: low (0.0 – 1.9 marks), medium (2.0 – 2.5 marks) and high (3.0 – 5.0 marks) (see Table 6.2). Through the stratified sampling process, participants from each subgroup were strategically selected (Gay *et al.*, 2012). One representative from each category was selected:

- Low: Participant 20
- Medium: Participant 23
- High: Participant 12

Table 8.1: Design Assignment 1 participant scores in categories

Low (0.0 – 1.9)		**Medium (2.0 – 2.9)**		**High (3.0 – 5.0)**	
Participant number	Average mark	Participant number	Average mark	Participant number	Average mark
1	1.5	6	2	12	3
4	1.5	7	2.5	16	4
8	1.5	9	2.5	17	3
10	1.5	11	2		
15	1.5	21	2.5		
19	1	23	2.5		
20	1				
22	1.5				
24	1				
25	1.5				

8.2.1 Participant 20

Participant 20 attended all the intervention cycles. The participant's MIDAS (Multiple Intelligence Development Assessment Scale) profile (Figure 8.3) indicates the intellectual disposition of the participant in each of the eight main intelligence areas (cf. section 2.2). The highest score was registered for interpersonal intelligence (66%), which was 6% higher than the average score of the participants overall. The lowest score was registered for spatial intelligence (23%), which was 13% lower than the average scores of the participants overall. Three of the participant's intelligence areas (i.e. naturalist, spatial and kinesthetic) were lower than the average score of the participants overall.

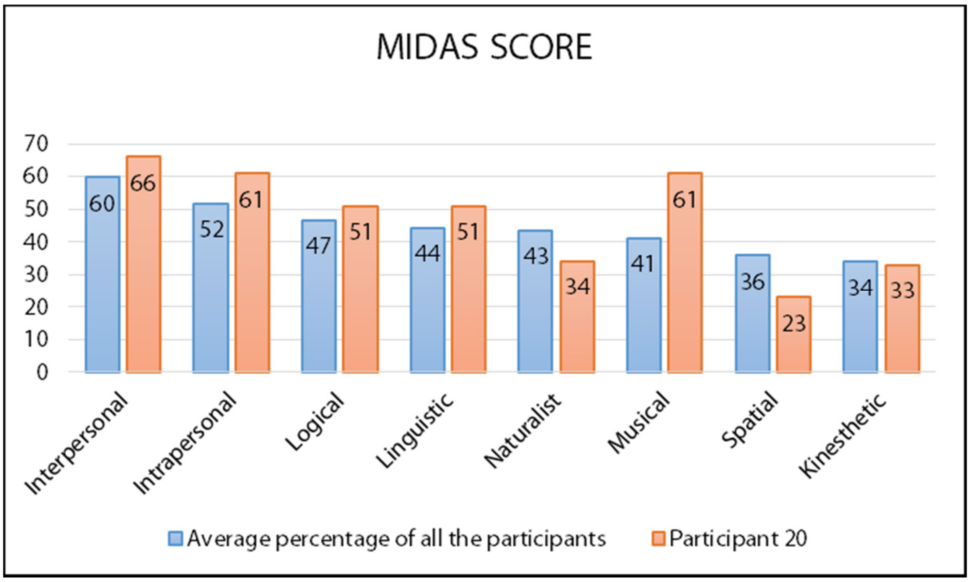


Figure 8.2: MIDAS score: Participant 20

The participant's design skill sets, see Figure 8.3, ranged from

- the highest score of 64% for the Emotional skill set (subjective and creative responses to design);
- 37% for both the Ideational skill set (visualization and representation of concepts, ideas and spaces) and the Logical skill set (rational and systematic approach to design); to
- the lowest score of 34% for the Sensory skill set (bodily experience in relation to the external environment).

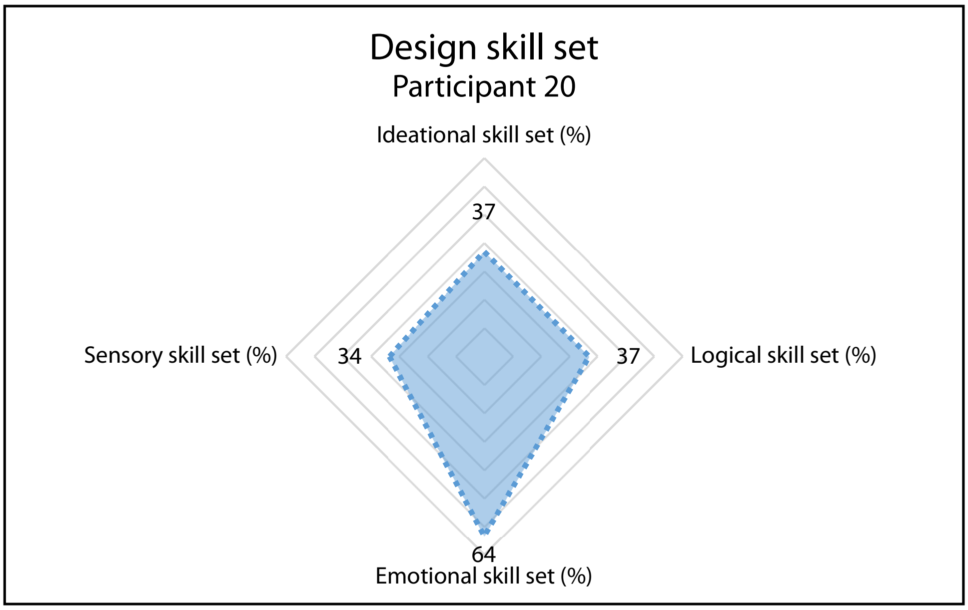


Figure 8.3: Design skill set: Participant 20

Participant 20's results for all five design assignments (Figure 5.5) indicated a 20% increase from a 20% (1 out of 5) average mark in design assignment 1, to a 70% (3.5 out of 5) average mark in design assignment 5. This improvement occurred in spite of a drastic decline of 30% in the average marks for design assignments 3 to 4.

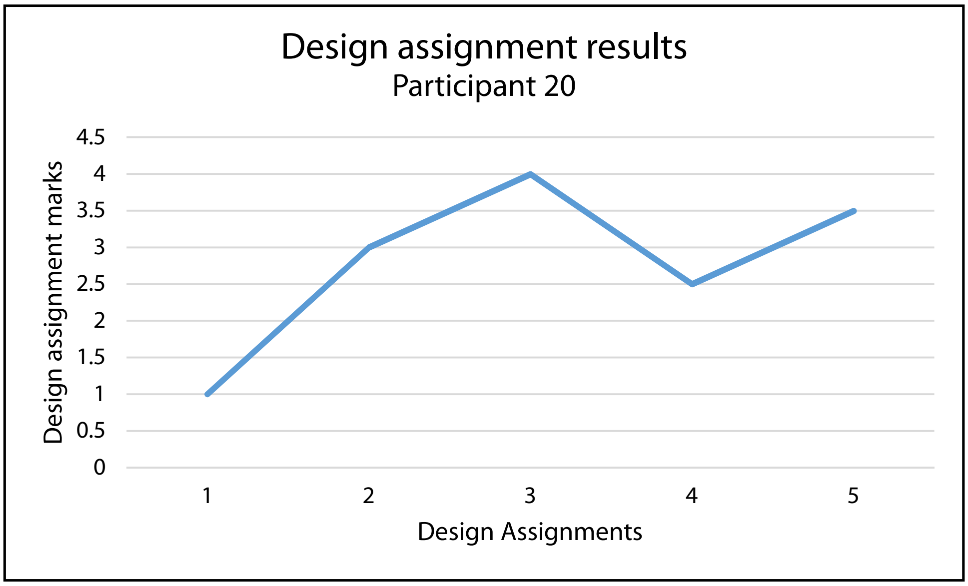


Figure 8.4: Design assignment results: Participant 20

8.2.2 Participant 23

Participant 23 attended all the intervention cycles. The participant's MIDAS profile (Figure 8.5) indicates the intellectual disposition of the participant in each of the eight main intelligence areas (cf. section 2.2). The highest score was registered for spatial intelligence (92%), which was 56% higher than the average score of the participants overall. The lowest score was registered for the naturalist intelligence (48%), which was 5% higher than the average score of all the participants. All eight of the participant's intelligence areas were considerably higher than the average score of all the participants.

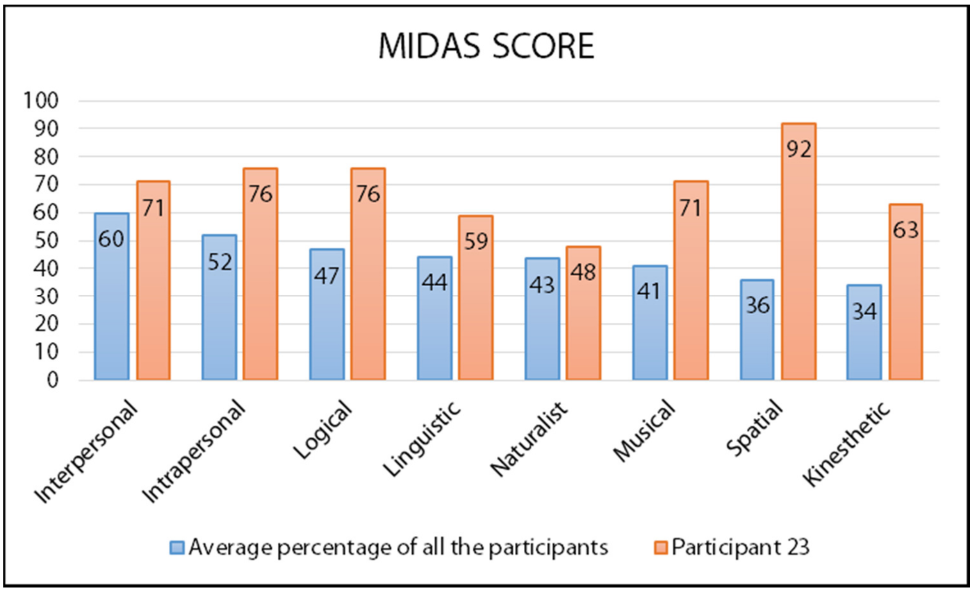


Figure 8.5: MIDAS score: Participant 23

The participant's design skill sets, Figure 8.6, ranged from

- the highest score of 84% for the Logical skill set (subjective and creative responses to design);
- 76% for the Ideational skill set;
- 74% for the Emotional set; to
- the lowest score of 56% for the Sensory skill set.

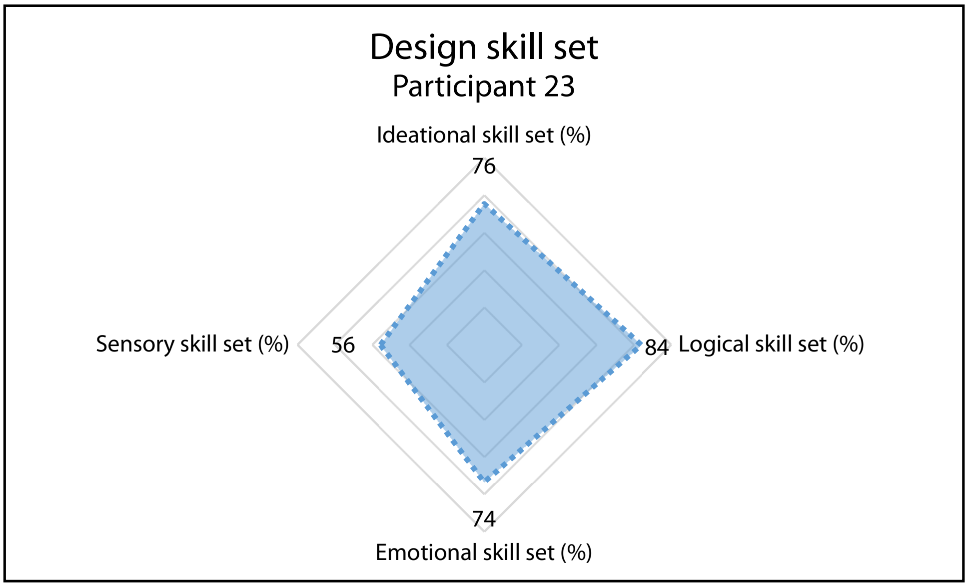


Figure 8.6: Design skill set: Participant 23

Participant 23's results of all five design assignments (Figure 8.7) indicated a 40% increase from a 50% (2.5 out of 5) average mark in design assignment 1, to a 90% (4 out of 5) average mark in design assignment 5, with a slight decrease of 10% in the average marks from design assignments 3 to 4.

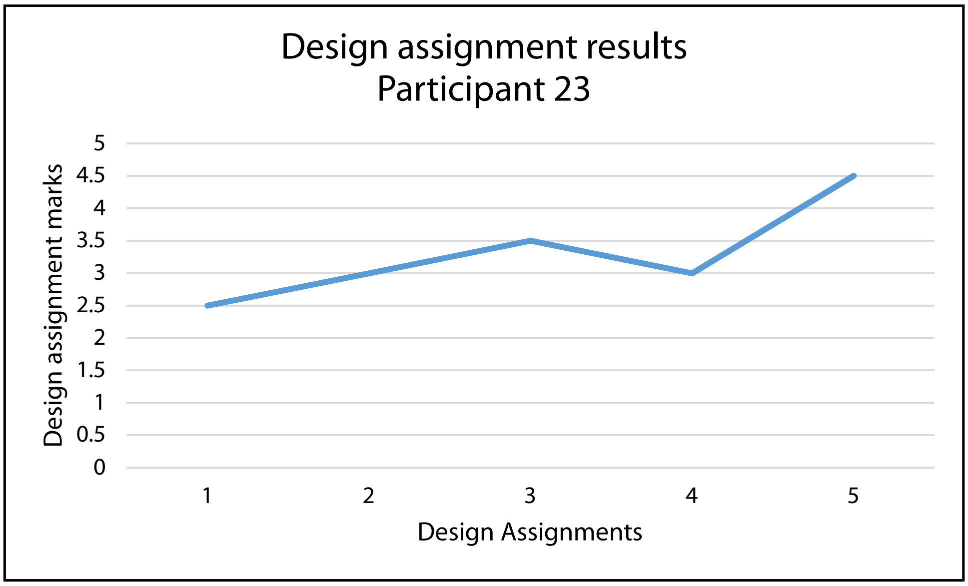


Figure 8.7: Design assignment results: Participant 23

8.2.3 Participant 12

Participant 12 attended all the intervention cycles. The participant's MIDAS profile (Figure 8.8) indicates the intellectual disposition of the participant in each of the eight main intelligence areas (cf. section 2.2). The highest score was registered for interpersonal intelligence (66%), which was 6% higher than the average score of all the participants. The lowest score was registered for the naturalist intelligence (23%), which was 20% lower than the average score of all the participants. All of the participant's intelligence areas were approximately the same as the average score of all the participants, except for interpersonal (6% higher) and naturalist (20% lower).

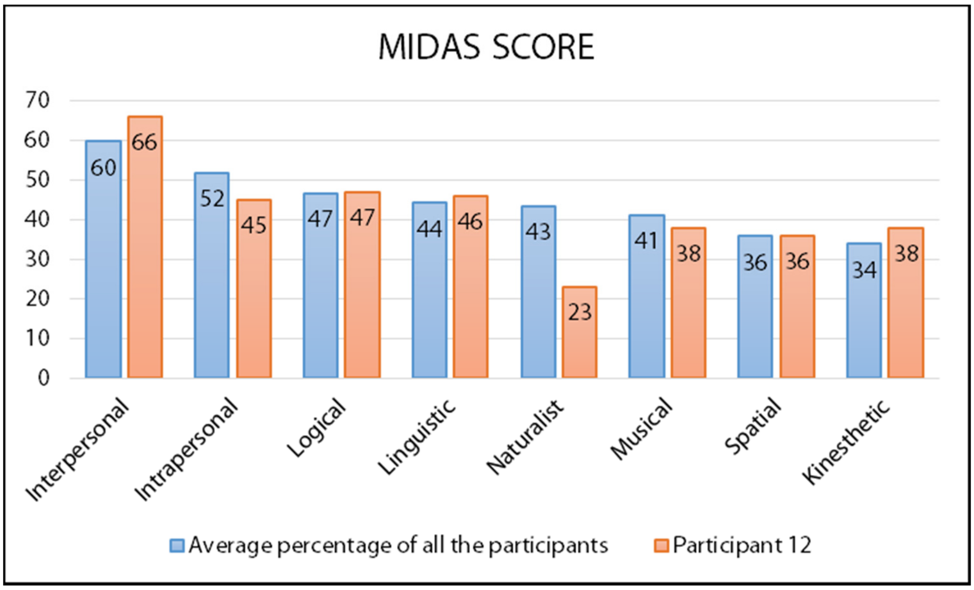


Figure 8.8: MIDAS score: Participant 12

The participant's design skill sets, Figure 8.9, ranged from

- the highest score of 56% for the Emotional skill set;
- 42% for the Logical skill set;
- 41% for the Ideational skill set; to
- the lowest score of 31% for the Sensory skill set.

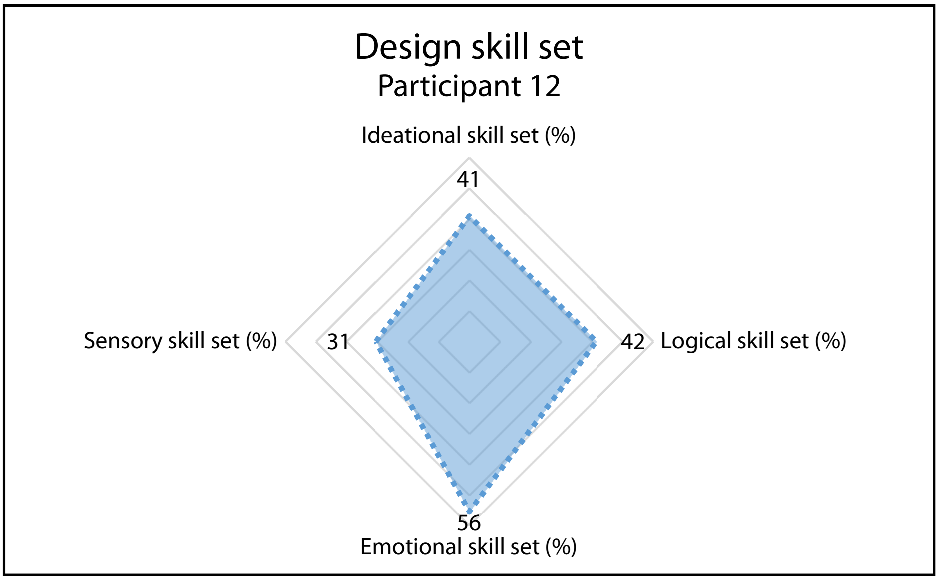


Figure 8.9: Design skill set: Participant 12

Participant 12's results of all five design assignments (Figure 8.10) indicated a 20% increase from a 60% (3 out of 5) average mark in design assignment 1, to an 80% (4 out of 5) average mark in design assignment 5, although there was a decline of 20% in the average marks from design assignments 3 to 4.

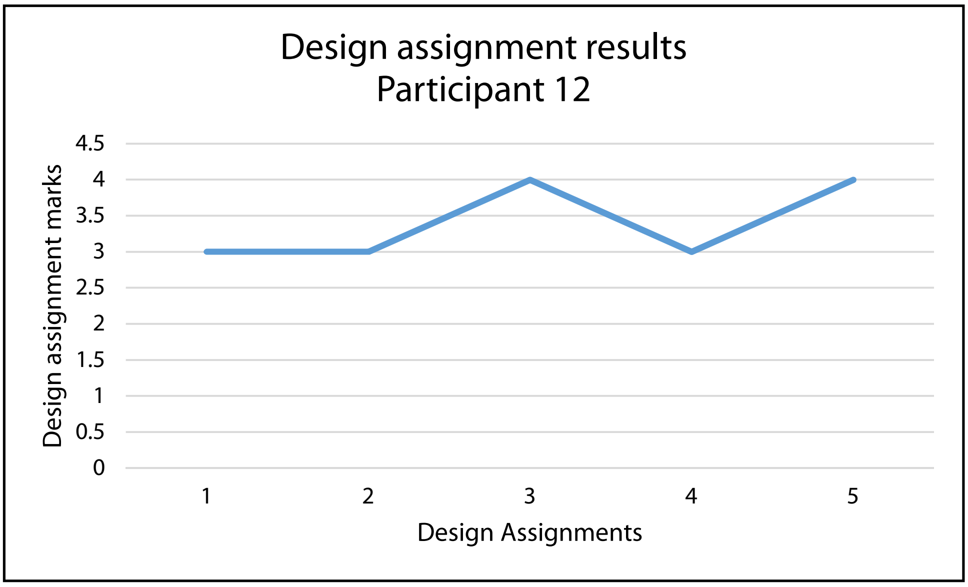


Figure 8.10: Design assignment results: Participant 12

In the next section, the narrative data of each participant was interpreted relative to the design skill set enhancement framework.

8.3 Design skill set development: Participant 20

Initially, Participant 20's level of creative self-efficacy was very low*:*

> *I am not an artistic person. I don't know anything about designs and stuff.*[113]

Creative self-efficacy, as defined by Diliello and others (2011), is a subjective belief in one's personal ability to be creative. In Participant 20, this belief was extended into a perceived low creative capability and creative self-image judgment (Tierney & Farmer, 2002), resulting in a resistance to engage in creative activities (Tierney & Farmer, 2002; Diliello *et al*., 2011):

> *So when I started the assignment my mind was blank.*[114]

Dilielo and others (2011) propose the concept of perceived organizational support (POS). Individual creative behaviour is, according to Plucker (2011), more likely to occur when a person perceives a learning environment that supports creativity.

The design skill set modal agencies, and more specifically the emotional modal agency, created a POS environment:

> *The first thing that helped me a lot outside was the peer groups because we were able to discuss it and as a group and everyone shares their opinion.*[115]

In the above quote, the participant suggested preference for working in a group. Figure 8.3 indicates the participant's emotional design skill set was the highest, namely 64%. The participant's results from the Multiple Intelligence Development Assessment Scale (MIDAS) Questionnaire[116] (Figure 8.2) concur with the participant's intellectual disposition, where - among the eight main intelligence areas - the score for interpersonal intelligence was the highest, namely 66%. Thus, by implementing Hanafin's (2014) concept of teaching through the intelligences (cf. section 2.2), the emotional modal agency created a POS environment.

The POS was particularly effectively created through the group-work semiotic tool, more specifically the implementation of the group-work process model (section 7.5) in iterative cycle 3. The large group concept created a bigger resource of knowledge and supported the meaning making process of that knowledge:

> *The big group, we were four so everyone gave their own opinion to what – if I don't understand, I would ask someone in my group to please explain to me what Mr Griesel wants us to do.*

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[113] Quote from the pre-intervention cycle, PAL recording.
[114] Quote from the pre-intervention cycle, PAL recording.
[115] Quote from iterative cycle 2, PAL recording.
[116] The MIDAS questionnaire was conducted during February 2017.

The 'study-buddy' concept, where each participant was co-responsible for another participant, supported the semiotic process by creating a supportive learning environment. The supportive learning environment enabled collaborative learning by encouraging active participation and social interactions. This created a safe collaborative learning environment where the students felt safe to explore their creative abilities (Lim & Plucker, 2001):

> *And the small groups were divided into – and we were discussing and we had to make rhythm using our hands.* [117]

Even though Participant 20's preferred skill set was emotional, and more specifically a high interpersonal intelligence, she displayed resistance to some of the physical group activities:

> *The second last thing*[118] *was the physical activities when we were asked to lie down or someone to lie down and you do rotation symmetry, I did not like it.* [119]

The resistance to the physical activities can be attributed to the very low sensory skill set of the participant (Figure 8.3), which corresponds to the low kinesthetic intelligence of 33%. The physical activities were related to the sensory modal agency, and more specifically the kinesthetic expression semiotic tool. These activities created the opportunity for participants to develop a sensitivity to body movement in space/orientation, visualizing how space unfolds with respect to human movement and exploring space and time relationships. As a consequence, the physical activities facilitated the semiotic transference from the theoretical concept into an indirect or abstract representation of a specific symbol. Due to the physical activities, the participant developed body movement sensitivity that assisted semiotic transference:

> *And I had a clear mind when we were asked to do, to show a focal point* [theoretical concept]… *a person who was dancing* [abstract representation] *and he was the one that is dominant.* [120]

Although the participant initially resisted the specific intervention, the concept of teaching to, for and through the intelligence enhanced the participant's sensory design skill set through the emotional modal agency, in particular the group-work semiotic tool.

During the Participatory Action and Learning (PAL) project in iterative cycle 2, Participant 20 reflected that the outdoor/natural environment was the preferred teaching and learning environment:

[117] Quote from iterative cycle 3, PAL recording.
[118] Rating from most influential to the least influential.
[119] Quote from iterative cycle 2, PAL recording.
[120] Rating from most influential to the least influential.

The outside one, because it had many examples.

The quote above highlights the participant's sensitivity to natural features, topography and materials, one of the required skills for the sensory design skill set. This preference for nature as a teaching and learning environment demonstrates, as Gardner (2016) recommends, that teaching and learning should be facilitated in a context that is authentic and relevant, integrating the outdoor environment as an integral and central component of the learning process. This also reflects the notion of Brown and others (2007) that knowledge and skills should be acquired in contexts that reflect the way in which knowledge will be applied in real life situations.

In an authentic contextual teaching and learning environment, Participant 20 was not only able to use her[121] physical and natural environment as a resource, but she also used it to bridge the gap between theoretical knowledge concepts and real-life application. She commented as follows:

We had to look for <u>examples of rhythms</u> in nature and we looking trees and cars outside. So at least we had an <u>idea of how our rhythm</u> is. [122]

The sensory modal agency stimulated the following required sensory design skills: a sensitivity to natural features, topography and materials, sensitivity to body movement and orientation, and a sensitivity to human scale.

Contrary to the participant's declared preference for the natural environment as a teaching and learning environment, she had a naturalistic intellectual disposition of only 34% (Figure 8.2), the second lowest of all eight intelligences. This is indicative that teaching to, for and through the intelligences exposed the participant to stimuli in areas not usually applied in classrooms and have developed those low intelligence areas.

The theoretical content course material semiotic tool (Ideational Modal Agency) was denoted by the participant as a source of various context-specific and abstract visual representamen that supported semiotic transference during the PAL project in iterative cycle 3:

The notes that Mr Griesel gave us, it explains everything in detail, and it had graphics [representamen] *that shows different types of rhythms.*

Furthermore, the participant found verbal explanations of the theoretical content course material semiotic tool particularly helpful:

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[121] The gender of Participant 20 is unknown but the female form of pronouns will be used when referring to her.
[122] Quote from iterative cycle 2, PAL recording.

> *he* [the lecturer] *was reading the notes and then explaining to us further on how rhythm is and how it works.*

The same effect occurred during iterative cycle 4:

> *As you see here,* [the] *lecturer helped me because he explained for us about scale and proportion.*

The verbal explanation, also part of the Ideational modal agency, facilitated the semiotic transference process between the theoretical concept (notes) and the sign. Even though the participant's ideational design skill set was originally indicated by the MIDAS test as low (37%), two of the ideational modal semiotic tools, namely the theoretical content course material and the verbal presentation semiotic tools, exposed and encouraged the participant to use two of the required skills within this skill set, i.e. the skill to articulate design ideas and the skill to implement verbal tools as analogy for design and knowledge transference. The participant referred[123] to an example (Figure 8.11) of using a verbal analogy to remember a theoretical concept:

> *It was the small to big that showed that we have to put something that is small to big or what is big to small.* [124]

Figure 8.11: Verbal analogy indicating proportion
Source: www.mediaintro.teeks99.com

During all the iterative cycles, the participant's narrative reflected that visual and verbal stimuli or analogies supported the semiotic transference and recollection of the theoretical concepts. This was specifically demonstrated by the re-contextualising of the context specific theoretical symbolic representamen into an abstract artefact, for example connecting an abstract visual analogy to a domain specific context artefact:

> *was the picture that had street lights* [abstract visual analogy] (Figure 8.12). *There were street*

Figure 8.12: Visual analogy indicating rhythm.
Source: www. lightphonic.wordpress.com

[123] PAL project in Iterative Cycle 3.
[124] Quote from iterative cycle 2, PAL recording.

> *lights like all over the world. The street lights, they are the same. They show repeating of the rhythm and the paving that was outside the picture and they showed regular rhythm* [domain specific context artefact]. [125]

This supports the claim of Casakin and others (2015) that analogical reasoning assists with the understanding of new knowledge by linking the 'unfamiliar' with the 'familiar'. In addition, analogical reasoning encourages the transfer of relational knowledge, or context-specific theoretical symbolic representamen, from a known situation to a situation that needs explanation (Moreno, Hernández, Yang, Otto, Hölttä-Otto, Linsey, Wood & Linden, 2014; Vosniadou & Ortony, 1989). The logical interpretation semiotic tool (Logical Modal Agency), through analogical reasoning, stimulated the following required skills of the participant's logical design skill sets:

- the ability to understand and apply abstract symbols[126];
- analytical and divergent thinking;
- the ability to understand the relationships between the whole and the parts;
- being able to successfully identify, and
- use design precedents to produce design variations and alternatives.

8.4 Design skill set development: Participant 23

Participant 23 stated[127] that he[128] was unfamiliar with the design environment and processes, and that this created a sense of confusion and uncertainty:

> *Okay basically during the design assignment, my mood was…I was actually very confused of what to do and how to go about it.*

With regard to the design environment, the participant accentuated the challenge of low design exposure and under-preparedness for design education of historically disadvantaged students. Yet, Cidre (2014) noted that novice design students are initially unable, or struggle to understand the design process or to communicate these ideas - and that this is a universal trait of students registered for design-based qualifications at higher education institutions. While classical psychological theory mostly conceive intelligence as an innate trait one is born with and which one can only minimally improve (Herrnstein & Murray, 1994; Jensen, 1993), Multiple Intelligence

[125] Quote from iterative cycle 3, PAL recording.
[126] Abstract Symbols: Arbitrary relationship with the object/concept – it does not look, sound, taste, smell of feel like the object. The link between the symbol and the object has to be learned.
[127] Quote from the pre-intervention PAL recording.
[128] The gender of participant 23 was unknown but will be addressed as "he" for practical purposes.

(MI) theory views intelligence as a combination of inherited potentials and skills that can be developed through relevant experiences (Gardner *et al.*, 1996). Thus, moving the focus away from the low design exposure and under-preparedness of the participant to rather focussing on the enhancement of these intelligences, and more specifically the cluster of domain[129] specific skills (Gardner & Moran, 2006) - the four design skill sets suggested by D'souza and others (2014) (cf. section 2.3) – can enhance students' prospects to succeed.

In the light of the previous paragraph, Participant 23's design skill set composite was revisited (*cf.* Figure 8.6). This showed the logical design skill set as having the highest score, namely 84%. Logical design skills (D'souza *et al.*, 2014) refer to the way designers understand and apply abstract symbols/formulae, formal logical thinking, deciphering codes, numerical calculations and problem solving. The participant's results from the MIDAS Questionnaire[130] (Figure 8.5) indicated his[131] intellectual disposition. Of the eight main intelligence areas, the score for spatial intelligence (understanding symbols, identifying, and designing formal strategies) was the highest, namely 92%.

During the PAL project in iterative cycle 2, the participant reflected that:

> *Then I saw the word focus* (Figure 8.13) *on the board, so I like sit and thought for myself and something that I learnt in class came to my mind and so I go, went up and did my idea.*

The above quote is indicative of the participant's spatial sensitivity to visual signs or representamen. These representamen facilitated the interpretational semiotic process (section 6.3) of re-contextualising the theoretical concepts by means of a representational shift called analogical reasoning. Analogical reasoning, suggested by Goldschmidt and others (2006), is very important in the early stages of the design

Figure 8.13: Visual analogy indicating focus. Source: www.experimentswithsuccess.com

129 A domain, defined by Gardner and others (2006), is any type of organized activity in which individuals demonstrate varying levels of expertise, applicable to a profession, discipline or craft.
130 The MIDAS questionnaire was conducted during February 2017.
131 The gender of Participant 23 was unknown but the male form pronouns will be used for practical purposes.

process, because the development of concepts and ideas during the early stages will influence the design decisions later. As can be seen by Participant 23's reflection[132]:

> *In the class the pictures helped me. Just reminds me of the approximate symmetry because it looks symmetrical but actually it's different. And the words* [verbal analogy] *twins and copy, it reminds me of a duplicate of something. Like everything has a duplicate. Remembering what we did yesterday because what we did yesterday helped me a lot because of things I forgot but going back and just sitting still then the stuff flowed back in my mind so I could write it more easily.*

Analogical reasoning assisted the participant in the process of identifying and developing examples, related projects, scenarios and connect experiences to solve design problems (Goldschmidt & Smolkov, 2006). The implementation of the concept of teaching in the intelligences (Hanafin, 2014), the logical modal agency, and specifically analogical reasoning, enhanced the participant's logical design skill set.

Participant 23 originally struggled to comprehend the relevancy of nature (domain specific context) in the learning process:

> *The tree, the tree wasn't like, because the tree didn't help me a lot.*

The initial resistance to nature as a teaching and learning environment could be a consequence of the participant's naturalistic intellectual disposition of only 48% (Figure 8.5), thus resulting in a low sensory skill set of 56%. However, the participant's bodily-kinesthetic intellectual disposition was much higher (63%), which is indicative of skills that are associated with visualizing or experiencing the movement of the body in relation with the external environment (D'souza, 2009).

Sensitivity to body movement, which is a sensory design skill, was implied by the participant during Iterative cycle 2:

> *The activities helped me a lot… we had to make shapes with our shadows outside and sometimes the shadows won't be like perfect how you want it. But we manipulated the shadows so we can have the perfect shape that we wanted to do asymmetrical.*

[132] PAL project in Iterative Cycle 2.

These 'activities' refer to the sensory modal agency, the kinesthetic drawing semiotic tool[133] and the kinesthetic expression semiotic tool[134], which use physical/kinetic semiosis to facilitate the modal agency meaning making process (Figure 6.3) of theoretical concepts. Through the implementation of the two above-mentioned semiotic tools, a sensitivity to human scale, ergonomics and accessibility was enhanced, as reflected by the participant:

> *we had to measure a lamppost and lie on the ground to show the scale, how big is it really.*

Conceding to Picciano's (2009) stance, students who are exposed to different teaching and learning modalities are enabled to experience learning in ways they are most comfortable in and are challenged to learn in other ways as well. This enhances Hanafin's (2014) concept of teaching to, for and through the intelligences.

After the kinesthetic drawing and kinesthetic expression semiotic tools intervention iterative cycle 2, Participant 23's perception of the outdoor natural environment changed. By using his logical design skills, he realised that nature is a vast resource of visual signs or representamen, and it provides a practical context-specific platform where the semiotic contextualisation process can be implemented. The participant reflected that[135]:

> *I want to see and do the work. Like if you talk about a tree show us how to, show first examples of a tree so I can do and then from that I can learn from that something.*

This outcome is underpinned by the claims of various scholars (Herrington & Herrington, 2008; Hill & Hannafin, 2001) that the domain specific context not only provides a large quantity of resources, but also reflects the manner in which knowledge can be used. In essence, context plays an important role in determining how a problem will be perceived as well as in providing support and strategies for solving it (Herrington, 1997). The natural iconic presentation semiotic tool (Sensory Modal Agency) incorporated the physical and natural environment as a resource for the semiotic contextualisation process and provided natural iconic[136] examples. Consequently, a sensitivity to natural features was created, which is a required sensory design skill. This sensitivity to natural features was expressed[137] by the participant:

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[133] Visualizing and physically expressing/re-presenting the theoretical concepts, by means of drawing human scale drawings, using the whole body to draw, thus the process rather than the visual product.
[134] Kinesthetic or physically interpreting (re–contextualising) the theoretical concepts by means of using their physical bodies in movement and poses to express the concepts by means physical abstract symbols.
[135] PAL project in Iterative Cycle 2.
[136] Iconic refers to the resemblance or imitation of the object (theoretical concept) by looking exactly like it (i.e. photograph) in nature.
[137] PAL project in Iterative Cycle 4.

example in nature, there are lots of examples that are also going to help me.

The participant's enhanced sensitivity to natural features and bodily movement (i.e. sensory design skills) created a modal platform where weaker design skills could be developed, in this case the ideational design skill (skills that allow for the visualization and representation of concepts, ideas and spaces). The direct presentation semiotic tool, an ideational modal agency, through the practical/physical implementation of step 2 of the modal agency meaning making process (Figure 6.3), facilitated the conceptualisation process between the theoretical concept and a context specific icon and created a resource of context-specific information. For example, from the following quote of Participant 23, it is clear that he was able to use the context-specific environment as the resource for the conceptualisation process:

> *The trees were like in the landscape* [context]. *There was no, almost like no buildings around it so it was just like a field with, I think, five. So that, it creates emphasis trees* [context specific icon]. *You must see it standing anywhere that's why it helped me a lot.*

The direct presentation intervention not only facilitated teaching and learning in a context that was authentic and relevant, but also followed Gardner's (2016) suggestion to organise learning in a sequence that shifts gradually from concrete to abstract.

The semiotic de-contextualisation process, an indirect representation semiotic tool that is part of the ideational modal agency, led to an indirect semiotisation process that re-contextualised the theoretical concept into a non-specific context so that it could be applied/represented in various contexts. According to the participant's observation[138], the semiotic transference between the theoretical concept and the context-specific icon was effective enough so that the participant could remember the context-specific icon and de-contextualise it into an abstract symbol:

> *The drawing of the leaf reflection and the tree. First the leaf reflection* [direct symbol] *helped me just to see the mirror effect because I had to draw a pattern* [abstract symbol] *the other student have to redraw. And the tree, we had to do a asymmetrical drawing and a symmetrical drawing of a tree and that was very helpful because now I can see the difference between those two.*

Both the direct presentation and indirect representation semiotic tools (ideational modal agency), stimulated the following required skills of the participant's Ideational design skill sets: ability to perceive the visual word accurately, ability to transform and modify initial perceptions

[138] PAL project in Iterative Cycle 2.

via mental imagery; aesthetic cognition, ability to see the qualities of design and visualization, and representation of concepts, ideas and spaces.

Participant 23 remarked[139] that the theoretical content course material semiotic tool, an ideational modal agency, extended the learning process beyond the classroom context and opened up more time for him to interpret the theoretical concepts:

> *The notes helped me, because I can go through the notes by myself, step by step following easily. So I can understand it better than just going fastly through it.*

However, language barriers that some students faced, hampered the effectiveness of the tool. Having to study in English, being a second or even third language for most students at CPUT (Ivala, 2009; Ralarala, Pineteh & Mchiza, 2016), reading and understanding the notes became problematic. Participant 23 observed[140] that both the theoretical content course material and the self-study semiotic tool were problematic:

> *the self-study and the notes, they didn't help me a lot because I studied, I went through them but I didn't understand it.*

Exacerbating these challenges was the participant's linguistic intellectual disposition of 59%. According to Kelly (2008a), students with weaker reading and writing skills are less inclined to be engaged, predisposing them to a cycle of reduced achievement growth which is aggravated by them being ill-prepared for tertiary education as a result of differing levels of academic preparation and interests (Ivala & Joseph, 2013). However, cognisance must be taken that student engagement, in the opinion of Reid & Solomonides (2007), is multifaceted, contingent on the relationship between lecturer and student and between student and peers, on the context of learning and the perception of learning the student brings to the study. When these are positive, it can cultivate a sense of belonging and enhance the identity development of the student. Collaborative approaches to learning, emanated from a social constructivist paradigm, use these multifaceted relationships through mutual engagement to collaboratively construct knowledge (Herrington & Reeves, 2011). Through the implementation of the group-work semiotic tool, an emotional modal agency - particularly the group-work process model (section 7.5) - created an environment that encouraged collaborative learning, supporting the transference of knowledge and skills, as confirmed by Participant 23:

> *The big group-work, it helped me a lot because more minds come together and we work better and more ideas can flow better.*

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[139] PAL project in Iterative Cycle 2.
[140] PAL project in Iterative Cycle 3.

This supported the meaning-making process of knowledge and the bridging of the language barrier by providing various perspectives on that theoretical concept. Furthermore the participant indicated[141] that the group-work semiotic tool, implemented in the natural environment (authentic learning environment), facilitated creative interaction among group members: *mostly the big group-work and the example in nature because in the big group you can, lots of people can put input, more input in and we can help each other understand the work.* This affirms Addison and others' (2010) standpoint that the extension of learning environments into the outdoor environment will foster creative development and construction of knowledge, especially with lower-achieving students. This also developed the participant's creative self-confidence and willingness to participate (Addison *et al.*, 2010), as reflected in the following comment[142]:

> *The activities helped me a lot, the group-work because we had to make shapes with our shadows outside and sometimes the shadows won't be like perfect how you want it. But we manipulated the shadows so we can have the perfect shape that we wanted to do asymmetrical.*

This also reinforces Donnelly and Fitzmaurice's (2005) argument that the providing authentic learning tasks and environments can fully engage the student. The emotional modal agency, and in particular the group-work semiotic tool, not only addressed the participant's engagement in his own learning environment, but also enhanced the following emotional design skills: an awareness of his personal knowledge and efficacy, ability to use analogy as a metaphor in design, sensitivity to larger social processes and leadership and the ability to involve his own personal experiences and reflection in design.

Even though Participant 23 struggled to understand the notes (ideational modal agency semiotic tool), as discussed in the previous paragraph, he noted[143] that the physical action of drawing (sensory modal agency) in the notes supported the visual recollection process of the theoretical concepts:

> *I love drawing and in the notes there was place for us to draw and that helped me a lot because we can see the things and draw it down so we can remember it.*

This co-implementation of the modal agencies not only facilitated the semiotic transference process, but also strengthened some of the weaker semiotic links created by the other modal agencies. This concurs with Kress's (1997) notion that all modes enable cognition, in particular

[141] PAL project in Iterative Cycle 4.
[142] PAL project in Iterative Cycle 3.
[143] PAL project in Iterative Cycle 4.

the conscious use of synaesthesia, a translation or transduction between modes and senses, resulting in a pedagogy that incorporates multiple entry points for meaning-making (Stein, 2007). Gardner (2016:50) made a similar point: "If you want to teach something that's important, there's more than one way to teach it."

8.5 Design skill set development: Participant 12

Participant 12's initial self-perceived creativity was quite high at the beginning of the pre-intervention PAL assignment:

> *At first time I knew what to do and I thought it was something that it was easy…I can do this.*

This highlights the goal-orientated and intentional nature of most creative activities. According to Dilliello and others (2011), people are usually aware that they are engaging in creative activities. However, even though the design assignment 1 results (Figure 8.10) indicated an average of three out of five for Participant 12, the participant's own perceived outcome of the assignment was quite negative:

> *And after that I saw what I have done and I was not impressed at all.*

This is indicative, as documented by Kruger and Dunning (1999), that when an individual has limited domain specific skills, he/she does not have the metacognitive abilities to accurately evaluate his/her performance in that domain. This is reflected in the participant's domain specific skill set results (design skill sets), as indicated in Figure 8.9, that ranged between a low of 31% to a high of 56%. These domain specific skills, and more specifically skills in design orientated domains are, according to Lawson (2005), complex and sophisticated. Domain specific skills is a flexible framework, as D'souza and others (2014) point out, of multiple skills that designers intentionally use to achieve desired goals. Participant 12 conceded that the various modal agencies, each specifically addressing a design skill set, facilitated the meaning-making process[144]:

> *The drawings as well helped me and the visual clues that we did yesterday and the lecture and the notes.*

This affirms not only Gardner's (2014) stance that skills can be acquired through various routes, but also Stein's argument that different modes and media can be used to teach different concepts, hence enabling different kinds of learning. Thus the designer, according to Barrow (2000), within the design domain, became the 'integrator' of various skills and knowledge.

[144] PAL project in Iterative Cycle 2.

The group-work semiotic tool (emotional modal agency) created an environment that encouraged the use of different knowledge resources[145]:

> *In the big groups, the big group-work helped me a lot because other people were bringing their own opinions and I was understanding what it was all about and having some clue of what I didn't know.*

This reinforces the intrinsic value of learning with others and of taking responsibility for one's own learning (Hernández, 2012). The participant's preference for working in a group correlates with her[146] score of 56% on the emotional design skill set (Figure 8.9) and concurs with her intellectual disposition where, of the eight main intelligence areas, the score for her interpersonal intelligence was the highest, namely 66% (Figure 8.8). Using her sensitivity to human behaviour and needs, a required design skill, developed her personal knowledge and efficacy as well as analogy and metaphor in design. In contrast, the participant noted[147] that the theoretical resources of another person, the 'study-buddy', were limited:

> *And the study buddy, the study buddy, we did the same thing. We didn't really understand what the notes were all about.*

Highlighting the language skill barrier, as previously discussed, the participant reflected that the language skill barrier not only resulted in a reluctance to self-study (emotional modal agency), but also in an inability to understand and use theoretical content course material, a ideational modal agency semiotic tool[148]:

> *The activities that we did yesterday, the least thing that helped me is the notes, I didn't understand the notes clearly. I needed to re-read it again.*

This draws the attention to the importance of the implementation of the group-work process model (cf. section 7.5), where group activities vary between large groups (explaining, discussing or making sense of the theoretical concept) and small groups (combining or presenting each other's ideas), because these can contribute to bridging the language barrier and provide various perspectives on a theoretical concept and reducing misunderstanding. Whereas Stein (2007) posits that some modes are better and more effective for certain tasks than others, D'souza and others (2014) suggest that it is the role of the instructor to determine the individual modes in which students operate. This again underscores the importance of the

[145] PAL project in Iterative Cycle 4.
[146] The gender of Participant 20 is unknown but the female form of pronouns will be used when referring to her.
[147] PAL project in Iterative Cycle 4.
[148] PAL project in Iterative Cycle 2.

implementation of more than one mode of learning, as argued by Ainsworth (2006:1): "two representations/modes are better that one".

Although the co-implementation of the 'study-buddy' semiotic tool and the theoretical content course material semiotic tool failed to facilitate semiotic transference, the co-implementation of the other semiotic tool, i.e. the kinesthetic drawing tool with the logical symbolic representation tool, made a positive contribution to the semiotic transference process, as reflected by Participant 12[149]:

> *The drawings as well helped me and the visual clues that we did yesterday.*

This acknowledges not only the participant's individual difference as an important factor to take account of in the teaching and learning process, but also the necessity of varying the instructional methods or modes to incorporate the participant's intellectual strengths for him or her to understand theoretical concepts (Akkuzu & Akçay, 2011).

During design assignment 2, Participant 12 indicated that she was unable to understand and apply abstract symbols (a required logical design skill) and to use geometric shapes to re-contextualise an Abstract Symbol to an Abstract Interpretation:

> *And then in class – but the shapes I didn't know what to do about the shapes.*

However, due to the analogical reasoning method, a logical interpretation semiotic tool - the visual and verbal analogies - supported the re-contextualisation transference between the Abstract Symbol and the Abstract Interpretation and stimulated the recollection of the theoretical representamen:

> *I didn't know what to do about the shapes exactly until I read the verbal information and what helped me in the verbal information is the picture of the opposite twins and then I remembered what we did yesterday.*

The participant observed her recollection of the theoretical representamen as follows:

> *what I remembered yesterday, it was the nature of how the sizes, the sizes of the trees and that's what made me remember of what to do on today's design, on the perspective one.*

The theoretical representamen, an outcome of the logical iconic presentation semiotic tool, supported the semiotic transference between step 4 and step 5 (Direct symbol to Abstract symbol) of the modal agency meaning-making process (Figure 6.4):

[149] PAL project in Iterative Cycle 4.

the sizes of the trees, to step 5 (Abstract symbol to Abstract interpretation): *made me remember of what to do on today's design, on the perspective one.*

The modal agency meaning-making process structured the implementation of all three logical modal agency semiotic tools. It facilitated the meaning-making process through the constant transition, translation and transduction between different modes (Kress, 1997). The logical modal agency stimulated the participant's skill to understand and apply abstract symbols in various contexts, identifying and using design precedents and understanding relationships between the whole and the parts.

8.6 **Conclusion**

The design skill set enhancement framework, through the co-implementation of the modal agency meaning-making process and design skill set modal agencies, enhanced the transfer of all three participants' design knowledge, and facilitated the development of the required design skill sets. Exposing the participants to the different modalities through the concept of teaching to, for and through their preferred skill sets, not only supported the participants to experience learning in ways they are most comfortable with, but also challenged them to learn in other ways - thus enhancing their underdeveloped skills. This illustrates the MI theory that intelligence is a combination of inherited potentials and skills that can be developed in diverse ways through relevant experiences. All three participants are capable of becoming good designers, in other words experts, in a domain that draws on their spatial intelligence. However, the pathways they travel in order to become good designers may differ quantitatively (i.e. speed) and qualitatively (i.e. process).

The design skill set modal agencies created a collaborative teaching and learning environment that encouraged the participants to engage and collaboratively construct knowledge that supported the semiotic transference process during the modal agency meaning-making process implementation.

The implementation of the design skill set modal agencies in an authentic, domain specific environment facilitated the participants' process of skills and knowledge development, bridging the gap between the theoretical knowledge concepts and the real life application and understanding of that knowledge. The study, due to the extent to which the theory informed and improved practice, consequently aligned with the pragmatic characteristic of DBR (Table 4.2).

In Chapter 9, the implications based on these findings and design principles are presented, and suggestions are made for future research, representing Phase 4 of the DBR process.

Chapter 9 :

CONCLUSIONS AND RECOMMENDATIONS

9

"What makes men learn? Not merely the sight of what they are accustomed to, but perpetual new experiences which throw them into a habit of tossing aside old ideas and forming new ones."

(Peirce, 1932:142)

9.1 Introduction

Chapter 1 introduced the study and proposed a rationale and direction for the rest of the investigation. Chapter 2 framed the study in terms of theory and Chapter 3 provided the contextual background of the study. Chapter 4 presented the DBR methodological framework in which the study was conducted. Phase 1 of the DBR process, namely analysing a practical problem, was discussed in Chapter 5. This was followed by the development of the design solution (Phase 2) in Chapter 6, conceptualizing an effective intervention. Chapters 7 and 8 represented Phase 3 of the DBR process, namely the implementation, analysis and interpretation of the intervention. The research design, characterised by four iterative cycles of development, was delineated in detail and the data was analysed in Chapter 7 and interpreted in Chapter 8.

Phase 4 of the DBR approach, inferred by Herrington and others (2007), includes the presentation of guiding principles and the dissemination of the findings for both theoretical and practical gain. The final chapter reviews and reflects upon the findings and offers a set of design principles for a multi modal/multi intelligence intervention as proposed in the study. The chapter concludes with a discussion of the limitations of the study and advancing recommendations, including future research possibilities. Figure 3.1 illustrates the positioning of Chapter 9 in Phase 4 of the DBR process.

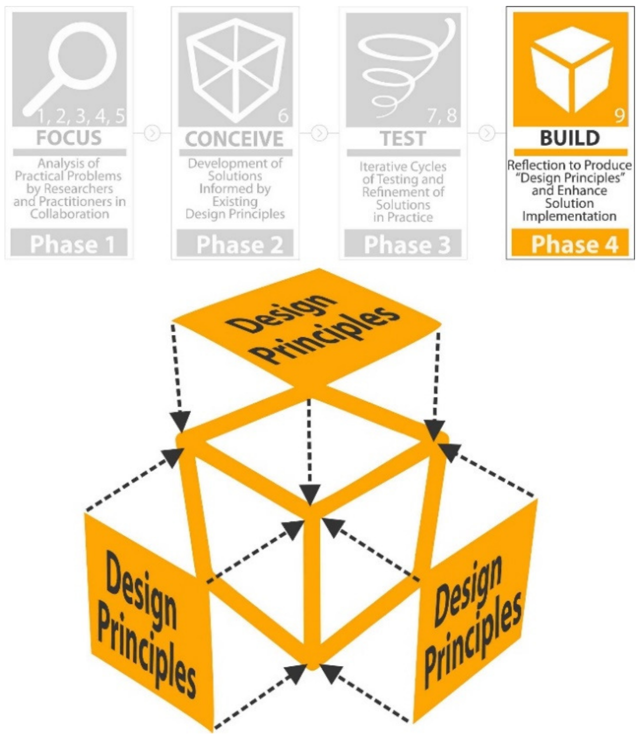

Figure 9.1: Reflection to produce new design education principles - positioning Phase 4

9.2 An overview: Rationale and research outcomes in context

Habit alone, maintains Peirce (1932:142), cannot produce development: "It is catastrophe, accident, reaction which brings habit into an active condition and creates a habit of changing habits" (my emphasis). This process of creating a 'habit of changing habits' is individualised and self-regulated (Peirce, 1932), dependent on a person's willingness to change his/her opinion (Kankkunen, 2004). This was elaborated further in the notion of Diliello and others (2011) that 'habit' is the structuring of experience that enables a person to make sense of a situation. In this notion of changing habits, this study set out to create an innovative intervention of meaning making to develop design skills among Foundation Programme Landscape Architecture students, and in the preceding chapters documented this cyclic DBR process.

The study departed from the argument that all individuals have the inherent ability to be creative, but that in some individuals, that ability has never been developed (or it was underdeveloped). This problem was further exacerbated by not only inappropriate assumptions about students' prior knowledge in current design teaching, but also the notion that the core values or fundamental aspects of creativity cannot be taught (Lu, Chen & Lee, 2016). The central argument of this thesis was that students' creative ability is a skill that can be learned and taught. This was further amplified by the notion that the development of these skills is contingent on a combination of multiple factors. Through the theoretical perspective of Multiple Intelligence (MI) Theory, various components or modal agencies were implemented to stimulate design skill development. Figure 9.2 provides an overview of the research study that consisted of the problem, the process and the findings.

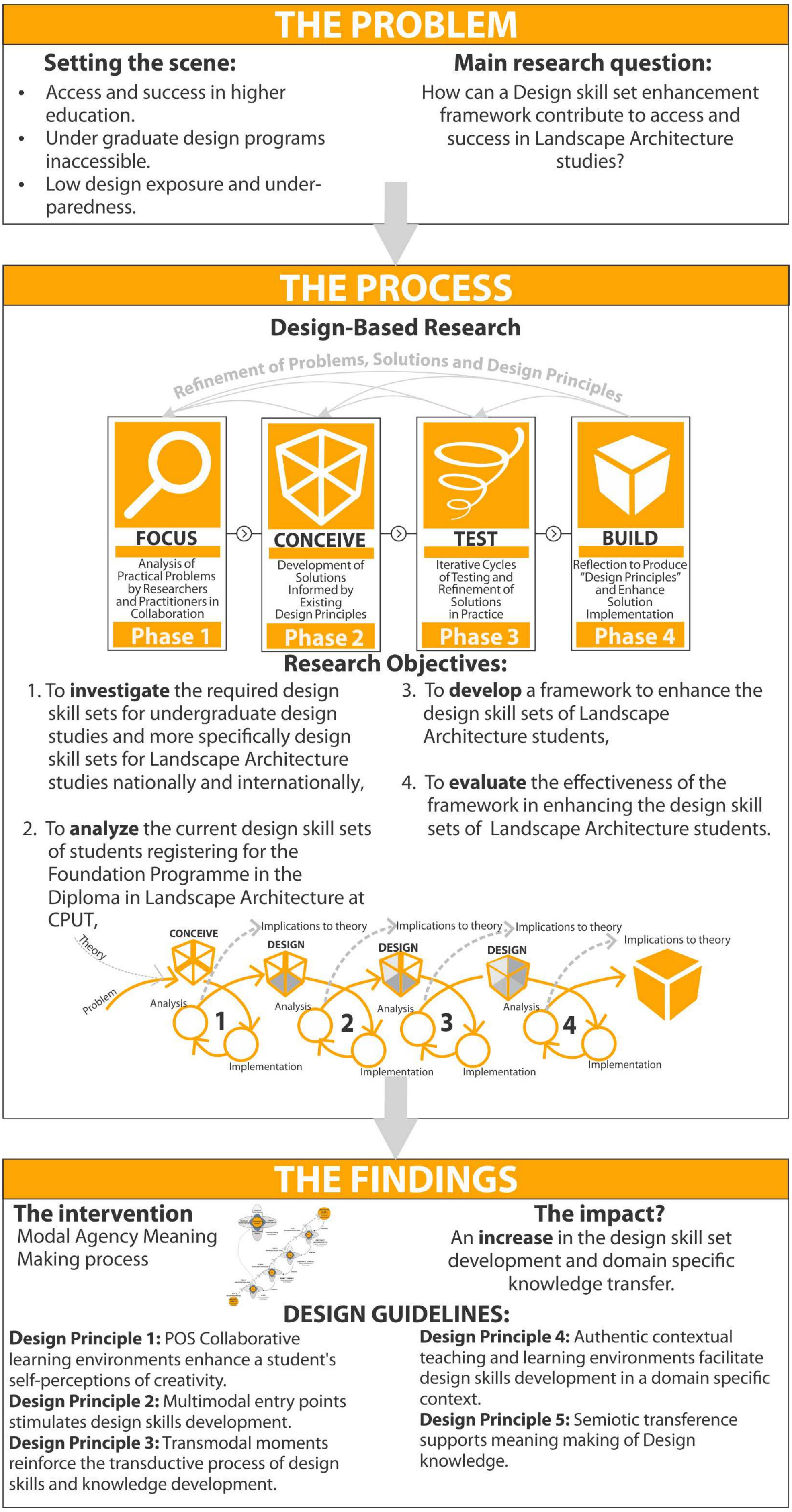

Figure 9.2: Research review

The Problem: Undergraduate design programmes, nationally and internationally, are being criticised for being inaccessible and catering only for a narrow group of students with specific skill sets and aptitudes (D'souza, 2009). This mismatch in specific skill sets that the majority of students in undergraduate design programmes experience, is aggravated by low design exposure and under-preparedness for higher education design studies. According to Cidre (2014), this is a universal trait of students registered for design-based qualifications at higher education institutions. Responding to international imperatives for access and fair chances of success, the primary research question of this study, in the context of Landscape Architecture education, was asked: *"How can a Design skill set enhancement framework contribute to access and success in Landscape Architecture studies?"*

The Process: The DBR methodology of the study was situated within a pragmatic paradigm, and guided by four definite objectives in an attempt to find an answer to the research question posed. Firstly, a list of required design skills for undergraduate design studies, and more specifically for Landscape Architecture studies, was developed. These skills, as suggested by D'souza (2009), were organised into four thematic design skill sets (see section 2.3.3). Secondly, the participants' design skill sets were measured and analysed (Chapter 5); this represented Phase 1 of the DBR methodology: analysis and exploration of the problem. The scores obtained for the design skill sets and MI outcomes compare with the scores obtained for the design assignment, highlighting the challenges of low design exposure and under preparedness that the participants experienced. The researcher's insights into these challenges were further enriched by analysing their perceptions of how they experienced the design process. Thirdly, collaboration with practitioners and a comprehensive literature review (Chapters 3 and 6) guided the conceptualisation process, representing Phase 2 (DBR). The intervention was implemented through four iterative cycles (Phase 3) of development, enactment and analysis of each cycle. This resulted in the consequential design principles (Phase 4), as discussed in the next section. The last objective was to assess the feasibility and effect of the interventions on the participants' design skill set development. This objective was realised through the use of various qualitative and quantitative data measurements (Chapter 4). The very purpose of DBR is to interrogate the relationship between the designed intervention and its effects on learning from many different angles (Kolmos, 2015).

The Findings: The rigorous in-depth interpretation of the data, and more specifically the data of three randomly selected participants (Chapter 8), produced encouraging results. The interpretation delved deeper into the design skill set heuristics that emanated from the multiple intelligence conjecture-driven teaching experiment. It is important to note that the design skill set framework merged the two components - the design knowledge semiotic process (DKSP) and the design skill set modal agencies - into the framework for the modal agency meaning making process (Chapter 6) (Figure 6.4). Exposing the participants to the different modalities through the concept of teaching to, for and through their preferred skill sets, not only supported them to experience learning in ways they are most comfortable with, but also challenged them to learn in other ways, thus enhancing their underdeveloped skills. This approach derived from the MI theory that intelligence is a combination of inherited potentials and skills that can be developed in diverse ways through relevant experiences. The framework created a collaborative teaching and learning environment that encouraged the participants to engage and collaboratively construct knowledge that supported the semiotic transference process during the modal agency meaning making process. The implementation of the modal agency meaning making process in an authentic, domain specific environment facilitated the participants' process of skills and knowledge development, bridging the gap between the understanding of theoretical knowledge concepts and the real life application of those concepts.

The research objectives have thus been achieved. The design skill set enhancement framework was developed and its feasibility and effect were evaluated. The intervention and its guiding principles were implemented at a foundation level, i.e. pre-first year level in higher education, within a disadvantaged socio-economic higher educational environment. An increase of various design skill sets and design attributes were observed. This intervention thus seems to be a feasible and effective teaching and learning tool to enhance design skill sets within the context described in the present study.

9.3 Lessons learned: Presenting the design principles

The purpose of this intervention was the development of a framework that could enhance the design skill sets of students in the form of design orientated semiotic processes and modalities.

One of the two primary contributions of Design-Based Research (DBR) is the development of a set of design principles, based on existing practical and theoretical principles, which can be used to guide the design and development of learning environments and pedagogies.

The goal of proposing these principles is not to create a set of mandatory procedures and processes for lecturers to implement, but rather to facilitate bridging the gap between educational theory and practice (Herrington & Reeves, 2011).

The design principles proposed in this chapter delineate a synthesis of conclusions drawn from this study and certain theoretical principles and design-based recommendations, discussed in Chapters 2 and 6, and highlighted during the analysis and interpretation of the data in Chapter 8.

9.3.1 Design Principle 1: POS collaborative learning environments enhance students' self-perceptions of creativity.

Creative self-efficacy is defined, for the purpose of this study, as an individual's belief in his/her ability or potential to produce creative outcomes (Plucker *et al.*, 2011). This belief, a product of an internalized and subjective self-assessment process, creates pre-conceived ideas of one being born either creative or uncreative. This pre-conceived notion of being uncreative is further amplified not only by a perceived lack of cognitive abilities associated with creativity (Moore, 2003), but also by limited exposure to a design environment. This was highlighted as one of the primary challenges in this study (Table 5.3), as mentioned by one of the participants:

> *I am not an artistic person. I don't know anything about designs and stuff.*

The participant's perspective, indicative of a low perceived creative capability and creative self-image judgment (Tierney & Farmer, 2002), resulted in resistance to engage in creative activities (Tierney & Farmer, 2002; Diliello *et al.*, 2011).

Collaborative learning, a social construct of knowledge, created the agency for the perceived organizational support (POS) learning environment (Diliello *et al.*, 2011) (*cf.* section 6.2 and 8.3). In this context, 'learning environment' was taken beyond the physical architecture of space where learning takes place to encompass psychosocial and pedagogical features also. The POS collaborative learning environment not only encouraged creative expression, but also individual creative behaviour. This, according to Plucker (2011), is more likely to occur when a person perceives a learning environment to support[150] creativity.

Collaborative learning, and in particular the group work mode of learning, has been used extensively by educators in various contexts. However, what distinguishes the group work mode of learning in this study is the fact that the group sizes varied during each learning activity (referred to as the group work process model in section 7.5), as well as the fact that the group created a safe environment where every participant could feel safe to explore his/her creative abilities (Lim & Plucker, 2001). Each group, through the group members' exposure to and increasing understanding of diverse perspectives, became an incubator of creative expression. The POS was particularly effectively promoted during the implementation of the group work process model, where the large group concept created a bigger resource of knowledge and supported the meaning making process of that knowledge. The 'study-buddy' concept (groups of two), where each participant was co-responsible for another participant, supported the semiotic transference process by creating a safe supportive learning environment that provided

[150] Support for creativity can be defined as the extent to which an individual who exhibits creativity perceives encouragement, respect, rewards and recognition (Zhou & George, 2001)

additional resources of information and augmented the lecturer's explanation of theoretical concepts (helping to bridge the language barrier, as discussed in Chapter 8), thus engaging the student in his/her own learning and development.

The contribution of the group-work mode of learning to the POS creative learning environment, as Diliello and others (2011) point out, is enhanced when group members are open to new ideas, constructively challenge one another, successfully manage conflict, share a commitment to their work and, finally, help and trust each other. The creative self-efficacy of each group member will be enhanced if all the group members are properly informed of these requirements. This will develop a sense of group metacognition, i.e. a group awareness of its own learning process (Plucker *et al.*, 2011).

However, cognisance must be taken that the group-work mode of learning, a preferred mode of learning for students with an interpersonal intelligence intellectual disposition, is not always a preferred mode of learning for other students with different intellectual dispositions (Gardner & Hatch, 1989). Conversely, according to Picciano (2009), exposing students to different modalities not only supports students to experience learning in ways they are most comfortable with, but also challenges them to learn in other ways as well (see Chapter 8, section 8.4).

This principle encourages a diversity in student approaches to identify and solve problems, affording that both skills and information reinforce and expand a student's creative ability and perceptions.

9.3.2 Design Principle 2: Multimodal entry points stimulate design skills development.

D'souza (2009) maintains that design skills cannot be restricted to a unique skill, for example drawing, but consist of a flexible framework of multiple abilities that designers intentionally use to achieve desired goals in specific design scenarios (see section 2.4.2). In this study, these abilities or design skill attributes (Table 2.3) were transcribed into modal entry points. Serematakis (1985:35) defines these entry points as 'meaning generating apparatuses' operating beyond consciousness and intention, and constituting inner states of feeling. These modal entry points are relativized, contradicted, or confirmed by embodied acts, gestures, or sensory effects. Gardner and others (1996) refer to these modal entry points as 'rooms' with at least six[151] 'doors'. The mindful use of these various modal entry points or 'doors' facilitates the activity of translation or transduction of design attributes between modes and senses, even if a particular mode is preferred to gain initial access to the 'room'. Kress (1997) points out that this ongoing cognitive process of transition, translation and transduction between the different modes is not easily

[151] The entry points are the narrational, aesthetic, logical-quantitative, foundational, experiential and social-cooperative, and map roughly onto Gardner's Multiple intelligences (Hanafin, 2014)

visible and exists beyond easy inspection. The reflection of one of the participants during the final iterative cycle of the study clearly demonstrates the importance of a modal entry point (in this case, physical/kinesthetic) in the transduction of a design skill (in this case, sensitivity to human scale and how space can be modulated):

> *I was actually part of it because we did the measurements one to one scale and then we had to reduce it to a certain scale. So it showed me how scale worked. It showed me the proportion.*

Multimodal entry points during each learning trajectory do not only facilitate the transference of knowledge through a student's preferred modes of learning, but also the implementation of the concept of the teaching to, for and through the semiotic modes (Hanafin, 2014). It also encourages the students to use and develop those skills in which they are not strong (see section 2.3). These entry points not only engage the interest and abilities of students (Klein, 2003), but also make the development of design skills more accessible to students with diverse intellectual abilities (Lynch, 1995). A participant in the study confirmed this when commenting on the implementation of two multimodal entry points. Firstly, a group-work or emotional entry point not only creates an environment that encourages collaborative learning, but also supports the transference of knowledge and skills:

> *The big group-work, it helped me a lot because more minds come together and we work better and more ideas can flow better.*

The second, a natural environment entry point, facilitates creative interaction between group members:

> *mostly the big group-work and the example in nature because in the big group you can, lots of people can put input, more input in and we can help each other understand the work.*

This highlights Kress's (1997) argument that there are 'best ways' of representing meaning, and that care must thus be taken with the selection of the modal entry points and the learning trajectory (see section 6.2.5). Multiple modal entry points shift the attention away from underdeveloped skills as barriers to teaching and learning (in particular language barriers, as in this study) (see section 8.4), conceding to Kress's (1997) notion that all modes enable cognition, i.e. language enables one form of cognition, physical activities another and drawing another. Hence, the different modal entry points each enabled a different form of cognition and skill development.

9.3.3 Design Principle 3: Transmodal moments reinforce the transductive process of design skills and knowledge development.

The affordance of a social semiotic and multimodal approach to learning is the recognition that different modes not only have different meaning making potentials, but also that the transformation of meaning through different modal agencies is a powerful catalyst for learning (Bock, 2016) (see section 6.3). The meaning making potential of different modes was patently evident in the study, as one of the participants reflected:

> *The visual clues that we did yesterday and the lecture and the notes I did not know what it was all about…..but once we did the physical activity and the drawing and the group-work, then I got to see what the lecturer was talking about in class and what the notes meant.*

This is corroborated by Stein's (2007:137) view that different modal agencies offer different potentials for representation: "some modes are better, more effective, for certain tasks than others".

Various researchers refer to this transformation process as re-contextualisation (Stein, 2000), synaesthesia (Kress, 1997), transmodalisation (Newfield, 2011) and transmediation (Crafton, Silvers & Brennan, 2009). This transformation or transmodalisation of meaning making through different modes, as defined by Newfield (2009), creates 'transmodal moments'. The simultaneous layering of modes, for instance a combination of verbal, sensory and kinesthetic modes in a single transmodal moment of interaction, facilitates the transductive process of meaning making (Bock, 2016; Stein, 2000; Newfield, 2011). This contribution to the transductive process was illustrated as follows by one of the participants:

> *And what helped me a lot, the physical activities* [kinesthetic mode] *because you could understand – we would say things* [verbal mode]. *We would say things and do them like the physical activities* [kinesthetic mode] *and examples in nature* [natural sensory mode] *about the regular rhythms.*

During a singular transmodal moment, the multiple modes must be coherent configurations and these configurations must meet some basic criteria. Firstly, Murphy (2012) suggests that these modes must be perceivable in the moment of action and treated as meaningful. One of the participants noted that, during a specific transmodal moment, one mode (natural sensory mode) not only facilitated his/her understanding of a theoretical concept, but also supported the transductive process into another mode (kinesthetic mode):

> *The examples in nature* [natural sensory mode], *like the buildings which showed emphasis. Ja, they helped me more and more with the physical poses* [kinesthetic mode].

Secondly, due to the fact that students have their preferred semiotic modes (Gardner, 2011), cognisance must be taken of the variance of different modal entry points (verbal/linguistic, logical/mathematical, musical, spatial, kinesthetic, intrapersonal, interpersonal and naturalistic) or, as Kress (1997) puts it, a complex ensemble of available resources (see section 2.3). These will act as motivational transformational forces through which the heightened enjoyment of the activities will trigger moments of learning (Newfield, 2011). This was evident from the following quote:

> *The drawings helped me a lot because I love drawing and in the notes there was place for us to draw and that helped me a lot because we can see the things and draw it down so we can remember it.*

Thirdly and finally, the combined meaning through the different modal configurations must convey more meaning than what is conveyed through an individual mode. These configurations, according to Murphy (2012), can either be synthetic (when the combined affordances of the individual modes create more complex or specific meanings) or prosthetic (when what is communicated in one mode will make more sense in the concurrent use of other modes). The influence of a synthetic configuration was reflected as follows by a participant:

> *But once we did the physical activity and the drawing and the group-work, then I got to see what the lecturer was talking about in class and what the notes meant.*

The following quote from a group interview refers to the influence of prosthetic modal configuration:

> *We saw things from nature* [natural sensory mode], *unlike before. Before it was just the pictures* [visual mode]. *And even with the pictures we didn't really understand what they were portraying or - but the information about the nature* [natural sensory mode], *it gave the true reflection through the leaves. We went out and picked the leaves and most of them were showing the exact reflection* [a theoretical concept].

In essence this quote above implies, as Kress (1997) argues, that if meaning making is an action, then the makers of meaning, i.e. the students, are 're-makers', 'transformers' and 're-shapers' of meaning and they will use the available resources provided through various modalities and redesign these according to their own interests and design skills. The student is placed in the centre of this socially dynamic meaning making process, and the transmodal moments encourage him/her to make meaning through innovative ways that stimulate imagination, experimentation and learning. The practical contribution of transmodal moments to the transductive process of meaning making was particularly highlighted in the following words of a participant:

> *So we discussed it and then after discussing it I had a clear picture of what it was all about. Then when we do the physical activities, the poses that we did also gave me a clear view of what we were doing. They show that what was told visually and so it was done physically….*[a week later] *I remembered what we did the past week and I remembered the poses we did, the drawings, the examples, the nature, the small group and the big group-work. And that made me able to know what to do… how to use different shapes and how to use different structures to do rhythm.*

The participant's reflection clearly indicates that a singular transmodal moment that consisted out of various modal agencies not only supported the transductive process of theoretical knowledge development (Figure 6.3), i.e. understanding and remembering the theoretical concept of rhythm, but also enhanced a design skill attribute, i.e. an ability to create and apply abstract symbols:

> *how to use different shapes and how to use different structures to do rhythm.*

9.3.4 Design Principle 4: Authentic contextual teaching and learning environments facilitate design skills development in a domain specific context.

Based on the social constructivist view that learning is a product of activity, culture and context, Gardner recommends (2016) that teaching and learning should be facilitated in a context that is authentic and relevant, reflecting the way in which knowledge and skills will be applied in real life situations (Brown *et al.*, 2007) (see section 6.2.2). Situating these experiences (meaningful activities) in an authentic and context specific learning environment, anchors the meaning making process of new knowledge and skills firmly into a domain specific context. Similarly, Stein (2007) observes that the way individuals make meaning is linked to their experiences of how extensively knowledge is contextualized in specific domains. In short, situated meanings are rooted in authentic experiences (Gee, 2004). In this study, the domain was Landscape Architecture and the context specific learning environment was a natural outdoor context. Therefore, as indicated by one of the participants, the authentic experiences in 'nature' codified theoretical concepts in the study field, Landscape Architecture:

> *What was important because of nature is that it made me to understand that the landscape, it's all about the study of the outdoors…Like we realised that the*

designing is not only about, like actually drawing or whatsoever. It's our everyday life. It's about everything that we see.

This aligns with the notion of Cope and others (2000) of situated practice, where practical knowledge is primarily situated in a particular sociocultural setting and contextualised in specific knowledge domains and practices.

The domain specific teaching and learning environment provides authentic, context specific, visual (iconic[152]) resources (see section 6.3). These resources, through the process of semiosis (Peirce, 1932), facilitate the allocation of meaning due to an individual's physical interaction with it (through multimodal entry points). Consequently the student or interpreter, through a context specific interpretation process (Figure 6.1), contextualises the mediate object (a theoretical concept) to an immediate object (transferred mental representation of the theoretical concept) (Plowright, 2011). The authentic visual resources, mentioned by a participant in this study, contextualised his/her interpretation of a theoretical concept (rhythm) to the domain specific context (nature):

And then the example in nature, they did help a lot, the flowers [iconic example] *that we have seen, they showed rhythm and it was easy for me to understand what rhythm really is.*

Furthermore, Herrington and others (2003) assert that authentic activities not only provide a variety of context specific resources, but also that these resources encourage students to examine a task from different theoretical and practical perspectives.

The contextualisation of meaning making is equally important in both the presentation and representation levels of the semiotic process (section 6.3), and not only functions on a denotative level (direct meaning of the sign), but also embodies a construction of understanding of information that is re-presented through the presentation or representation of selected ideas, information and knowledge (Nadin, 1988). This interpretation process, specifically highlighted by Goldschmidt and Smolkov (2006) as a generation of both 'inner representations' (or transferred mental representations), and 'external representations' (context specific icons), influences the design thinking process and particularly design skill attributes, for example the ability to understand and apply abstract[153] symbols, formal logical thinking, deciphering codes, and design problem solving. This ability of understanding and applying

[152] An icon resembles or attempts to replicate the object by looking, sounding, tasting, smelling or feeling like it.

[153] Abstract Symbols: Arbitrary relationship with the object/concept – it does not look, sound, taste, smell of feel like the object. The link between the symbol and the object has to be learned.

abstract symbols to resolve a design problem was clearly revealed by one of the participant's design thinking process reflections:

> *I remembered what we did the past week and I remembered the examples in nature. And that made [me] able to know what to do… how to use different shapes and how to use different structures to do rhythm.*

This was substantiated by Herrington's (1997) notion that meaningful learning will only take place if the learning of knowledge and skills is embedded in a context that reflects how it will be used in real life. This enables the internal process of learning by implementing a set of external events, or authentic activities, where learning will happen without instruction (Gagne, Wager, Golas, Keller & Russell, 2005).

Implementing authentic activities in a domain specific teaching and learning environment not only creates a learning environment that enables and motivates students to learn (Faasen, 2016), but also establishes meaningful linkages that promote connections among knowledge, skill and experience (Choi & Hannafin, 2011).

9.3.5 Design Principle 5: Semiotic transference supports meaning making of design knowledge.

Knowledge, and specifically design knowledge or - as Cross (2006:5) refers to it - "a designerly way of knowing", is differentiated by Lawson (2004) as episodic (experimental) knowledge and semantic (theoretical) knowledge. Design knowledge, in particular, is heavily dependent on episodic knowledge, especially episodic processes of meaning making (Hokanson & Gibbons, 2014, Casakin & van Timmeren, 2015; Gardner, 1999).

In this study, semiotic transference (see section 6.3), i.e. transferring certain qualities or meaning from one sign to another (Hess-Lüttich, 2003), encouraged meaning making through a sequential interpretation process (see section 8.4). This process incorporated not only Peirce's (1932) process of semiosis, i.e. the interaction between a sign, an object and an interpretant, but also the analogical reasoning processes of transferring relational knowledge from the 'familiar' to the 'unfamiliar' (Casakin & Van Timmeren, 2015) (see section 6.2.4). Although these processes of analogical reasoning and semiosis have been extensively implemented in various design education contexts (Casakin, 2010; Casakin & Goldschmidt, 1999; Medway & Clark, 2003), what was original in this study was not only the co-implementation of both processes in a domain specific context, but more importantly the methodical, step-by-step transference of a theoretical concept to a conceptual or mental representation. Stein (2007) refers to this sequential interpretation process as 'semiotic chains', where teaching and learning occur through the ongoing creation and mediation of signs (Figure 6.4). For example, in this study, a participant reflected that the practical/physical implementation of step 2 in the Design Knowledge Semiotic Process (Figure 6.2) facilitated the interpretation process between the theoretical concept and a context specific icon:

> *The nature, the nature helped, the flowers* [context specific icon] *because we learnt in the class that there were alternating rhythm* [theoretical concept] *and there was a direct, that the rhythm was giving the direction. So because of outside where we were doing all this, there are plants and the plants are put in the direction and in rhythm so that also helped.*

Transmodal moments (episodic activities) in semiotic chains created 'fixing nodes' for semantic design knowledge. Newfield (2011) refers to this as a dynamic process that produces moments of 'fixing' in the semiotic chain of learning or semiotic mode of realisation (Kress, 1997). In the context of this study, one of the participants indicated how a specific transmodal moment (drawing) created a fixing node in his/her mind:

> *Yes, because when you draw something your mind is a picture and it's imprinted into your mind so we won't forget it. It's like you drew it and you have it installed in your mind.*

Although these conscious and systematic shifts across modes are significant factors in learning where the object appears to be 'fixed', the outcome thereof is still connected to their modal preference (Stein, 2004; Gardner, 2011) and unstable links in the semiotic chain remain. For example, a participant in this study acknowledged that a weak semiotic link between the theoretical concept and the context specific icon created difficulty for him/her in remembering a theoretical concept:

> *didn't really remember any of them well, not as easily …like I was lost. I saw these shapes. I wasn't sure like what to do.*

Semiotic transference of semantic knowledge in a domain specific context supports the shaping of emergent meaning and, according to Cope and others (2000), these 'meanings' act as meaning making resources for new constructions, representations and the re-semiotisation of semantic knowledge (Kell, 2015). These context specific emergent meanings help the student with what Cross (2006) refers to as 'lateral transformations' in the meaning making process, facilitating the meaning making shift into new contexts. As a result, these 'lateral transformations', indicated by the participants in this study during a group interview, made them aware that they could de-contextualise a context specific emergent meaning and transfer that meaning to an indirect representation, and even extend that into other contexts:

It helps us a lot because now with rhythms from the nature that were there, you could see the rhythms not limited into the landscape only. It is there in clothing and stuff like that. Now we are able, like we can see, we can spot it wherever it is.

This concedes to both Gardner's (2011) and Akkuzu's (2011) notions that learning in authentic and relevant contexts - through a sequence that shifts gradually from concrete to abstract - not only facilitates the transference of knowledge, but also highlights the cognitive and emotional aspects during the meaning making process.

9.4 **Challenges and limitations of the study**

Low design exposure and under-preparedness in design education on the part of the participating students was a significant challenge in this study. This was particularly evident during Phase 1 (pre-intervention analysis) of the DBR process that outlined the specific challenges the participants faced (see section 5.4). This highlighted not only the participants' unfamiliarity to a design environment, but also their limited exposure to basic design terminology. However, the DBR methodological aspects adopted in this study accentuated the importance of not only creating authentic contextual teaching and learning environments that build resources for real life application and understanding of design problems, but also encouraged the participants to experience the freedom to explore their own creative potential and self-confidence. Although the domain specific teaching and learning environment (nature) facilitated cognition of domain specific knowledge (Chapter 7), some participants initially resisted using nature as a resource for meaning making.

The participants' socio-economic backgrounds and language barriers (Ivala & Joseph, 2013) reduced the participants' initial engagement in the study (see section 8.3). Nevertheless, the framework was developed in such a way that it created an environment that not only encouraged collaborative learning, but also provided various modal entry points that supported the transference of knowledge and skills (refer to Design Principle 2).

The scope of the study was restricted to the domain of Landscape Architecture, and more specifically to students that started with the Foundation Programme in Landscape Architecture at CPUT. The study had a dual emphasis on content and pedagogy. The content specifically focussed on basic design theoretical concepts, elements and principles. It was selected because it is essential to design students' education and contributes substantially to their design skill sets (Adams, 2013). The pedagogy focussed on both semiotic processes and multiple modalities. Although the duration of the study and specific context of the study can be considered sufficient for the study's aims, a longitudinal study with different cohort groups exposed to repeated and expanded intervention cycles, tracing their progress all the way to graduation, could add to the output value.

One feature of the study that can be seen as either a limitation or a strength, is the fact the researcher was also the practitioner, thus directly involved with the research process. Although participants might react differently in an experiment than they would in real life, because they know they are part of a study, the participatory nature of DBR is particularly valued in literature as a benefit (Chapter 4). In this study, the research design played a noticeable role and effectively created a link between pedagogical practice and theoretical understanding.

Secondary to the main challenges of this study was the creation of various transmodal moments for each learning trajectory. Creating and linking various transmodal modes during a singular transmodal moment, required not only very specific knowledge regarding different transmodal entry points, but also extensive planning to implement these moments in a context specific domain. This might be regarded as a limitation to the replication of such a type of intervention by other researchers in the future.

9.5 Contributions of the study and future prospects

The outputs of this DBR study are both knowledge and products (Herrington *et al.*, 2011). The knowledge claim of this study, differentiating it from other research studies, takes the form of the design principles outlined in section 9.3. These design principles contain descriptive/declarative and prescriptive/procedural knowledge to guide and inform future development and implementation decisions (McKenney & Reeves, 2012).

The principal goal of educational research should be the solving of teaching, learning and performance problems (Herrington *et al.*, 2011). The design product in DBR is the primary output; thus, the design skill set development framework is the primary output of this study. The framework created an authentic teaching and learning environment that facilitated skills and knowledge development through the co-implementation of transmodal moments and sequential semiotic transference during the meaning making process of both episodic (experimental) knowledge and semantic (theoretical) knowledge. The intervention design was essentially based on both Gardner's multiple intelligences theory and Peirce's semiotic paradigm of meaning making. This is an original practice-orientated contribution to the context of the study. This study argues for a holistic and differentiated approach to creative skills development, given the contextual issues of access to and success in design studies in the higher education environment.

The collaborative nature of the research approach not only facilitated the development of the participants, but also the development of the profession, or as referred to by Herrington and others (2011), 'societal outputs'. These professional outputs were not limited to the people involved in the study, but were also extended into both the larger design education milieu and more specifically the Landscape Architecture Profession. The multimodal, student centered approach to teaching and learning offers both a richly diversified way of understanding and categorizing human cognitive abilities and honours and celebrates diversity. This addresses the limitations and restrictions resulting from assumptions of students' prior knowledge, abilities and under-preparedness, as well as the notion that undergraduate design programmes only cater for a narrow group of students with specific skill sets and aptitudes.

Even though DBR as a methodology is very context specific and not necessarily generalizable, the domain specific environment has been described in detail. This allows for the possibility of the interventions to be adapted and adopted in another context, broadening the validity of design studies and especially ecological validity.

The strength of DBR lies in the repeated iterative testing of interventions, producing even more refined and improved design principles. The design considerations reflected in the current study have not yet been fully explored. It might be of particular benefit to repeat this type of interventions in different year levels (1st year, 2nd year, or 3rd year students) and/or within different domain specific contexts (i.e. architecture or graphic design) to assess how the design skill sets would be affected. Longitudinal studies are further advised to determine whether early effects have long-term potential.

Finally, responding to the primary research question (section 1.3), the researcher concludes that the design skill set development framework, conceptualised in this study, is feasible (Chapter 7) and has succeeded (Chapter 8) in enhancing the design skill sets of Landscape Architecture students.

9.6 **Final thoughts**

"If you hear a voice within you say 'you cannot paint,' then by all means paint, and that voice will be silenced"[154] *– Vincent van Gogh*

The artistic accomplishments of Vincent van Gogh, one of history's greatest artists, were not the result of an inherent creative 'talent'. In a letter that he wrote to his brother Theo in 1885, he conceded that many people are cleverer and more talented than he (Brower, 1996). David Sweetman's biography, *Van Gogh: His Life and His Art* (1990), gives a detailed description of his intention to be an artist and his limitless capacity for hard work to become one. Through his

[154] Retrieved from *https://www.brainyquote.com/authors/vincent_van_gogh*

persistent dedication, he turned himself into an artist; in van Gogh's own words: "In spite of everything I shall rise again and take up my pencil and draw and draw" (Sweetman, 1990).

Research has shown that nearly all children are born with a creative ability and that ability is a skill that can be learned and taught (Casakin & Goldschmidt, 1999; Gardner & Moran, 2006; Lawson, 2004; Moore, 2003). Within design orientated occupations, i.e. artists, landscape architects, fashion designers etc., design is regarded as a highly complex and sophisticated skill (Lawson, 2005). D'souza and others (2014) elaborate on this by hypothesizing that design skills cannot be restricted to a unique skill, but rather involve a flexible framework that consists of multiple abilities that designers intentionally use to achieve desired goals in specific design scenarios.

This research attempted to make a contribution to the critical area of design skills development and offers an innovative approach to not only enhance the development of design skills, but also to facilitate cognition of domain specific knowledge. Social semiotics and transmodal moments create cognitive entry points during the meaning making process; these entry points will not only engage the interest and abilities of students (Klein, 2003), but will also make the development of design skills more accessible to students with diverse intellectual abilities.

The importance of this contribution is shown by the following statement of Professor Jonathan Jansen[155]:

> . . . in matters social as well as educational, the best tool at our disposal as human beings is to think our way out of problems; far too much emphasis in South African education is on coverage of content and too little on the underlying thinking skills crucial for understanding complex scholarly and social problems.

In conclusion, referring back to the quote of Edwin Catmull, the co-founder of Pixar Animation Studios and president of Pixar Animation and Disney Animation (Chapter 2): everybody has the potential to be creative; it is the role of educators to acknowledge that potential and to create a teaching and learning environment that will foster and encourage creative behaviour.

[155] Retrieved from https://thinkingschoolssa.co.za.www36.flk1.host-h.net/home/

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Addendum A: Ethical clearance approval from Stellenbosch University

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Approval Notice
New Application

26-Jul-2016
Griesel, Gerhard GJC
Stellenbosch, WC

Proposal #: SU-HSD-002613
Title: A framework for enhancing the design skill-set of Foundation Programme Landscape Architecture students.

Dear Mr Gerhard Griesel,

Your **New Application** received on **23-Jun-2016**, was reviewed
Please note the following information about your approved research proposal:

Proposal Approval Period: **15-Jul-2016 -14-Jul-2019**

Please take note of the general Investigator Responsibilities attached to this letter. You may commence with your research after complying fully with these guidelines.

Please remember to use your **proposal number** (**SU-HSD-002613**) on any documents or correspondence with the REC concerning your research proposal.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

Also note that a progress report should be submitted to the Committee before the approval period has expired if a continuation is required. The Committee will then consider the continuation of the project for a further year (if necessary).

This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki and the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health). Annually a number of projects may be selected randomly for an external audit.

National Health Research Ethics Committee (NHREC) registration number REC-050411-032.

We wish you the best as you conduct your research.

If you have any questions or need further help, please contact the REC office at 218089183.

Included Documents:
DESC Report
DESC Report 1
REC: Humanities New Application

Sincerely,

Clarissa Graham
REC Coordinator
Research Ethics Committee: Human Research (Humanities)

Addendum B: Institutional permission from Cape Peninsula University of Technology

Cape Peninsula University of Technology

FUNDANI CENTRE FOR HIGHER EDUCATION DEVELOPMENT

P.O. Box 652, Cape Town, 8000, South Africa. Tel: +27 21 460 3922. Fax +27 24 460 3711

14 September 2016

OFFICE OF CHAIR: FUNDANI CHED RESEARCH ETHICS COMMITTEE (FREC)

ETHICS APPROVAL

Approval was granted to **Griesel Gerhard** to conduct research activities as stated in the proposal.

Proposal Title: ***A framework for enhancing the design skill-set of Foundation Programme Landscape Architecture students.***

Any adjustments to the protocol must be submitted to the Ethics Committee for approval.

We wish you well in your research and look forward to your dissemination of the findings.

Yours faithfully
Nosisana Mkonto (PhD)

CHAIR: FUNDANI RESEARCH ETHICS COMMITTEE
Email: mkonton@cput.ac.za
Website: http://www.cput.ac.za

Addendum C: Student consent form

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STELLENBOSCH UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

A framework for enhancing the design skill-set of Foundation Programme Landscape Architecture students

You are asked to participate in a research study conducted by Mr. Gerhard Griesel ML(Prof), from the Department of Education – Curriculum Studies at Stellenbosch University. You were selected as a possible participant in this study because you are a registered student in the Foundation Programme and Landscape Architecture.

1. PURPOSE OF THE STUDY

The purpose of this study is the widening of access to the professional discipline of Landscape Architecture by enabling students to successfully complete their studies in Landscape Architecture. The study aims to develop a framework that could enhance students' design skills, thus broadening the selection of students to successfully complete their studies in Landscape Architecture.

2. PROCEDURES

If you volunteer to participate in this study, we would ask you to do the following things:

You would have to complete a questionnaire in the beginning and the end of the year.

You would have to participate in four design skill-set intervention cycles. Each cycle will consist of three x 40 min contact sessions over four weeks. You would be asked to complete various design tasks. These tasks will be recorded by video (the camera will only focus on your design and your voice, you will not be identified) and hard copies. At the end of each cycle you will have an individual discussion with the researcher discussing your design process, only you voice will be recorded.

3. POTENTIAL RISKS AND DISCOMFORTS

No negative consequences of any sort are expected.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

You will not benefit directly from participating in the study.

5. PAYMENT FOR PARTICIPATION

You will not receive payment for participation in the study

6. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law.

Confidentiality will be maintained because participant will be allocated a number as a form of identification, there will be no connection between the allocated number and the participants' identification. All the research data will only be identified by the allocated number.

All the research data will be locked up in a secured locker in the researcher office and the electronic data will be password protected

You have the right to access, listen and edit all audio and video recordings of yourself. These recordings will be stored in a secured locker and electronic data will be password protected.

7. PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so

8. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact Mr. Griesel (Principal Investigator) at 083 4156260 of email him at grieselg@cput.ac.za or you can contact

9. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development or you can contact Mr Buyani Ntomboxolo at CPUT's Student Counseling Department in Bellville [Student-Counselling@cput.ac.za; 021 959 6182]

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to me by Mr. Gerhard Griesel in English and I am in command of this language. I was given the opportunity to ask questions and these questions were answered to my satisfaction.

I hereby consent voluntarily to participate in this study. I have been given a copy of this form.

____

Name of Subject/Participant

____

Name of Legal Representative (if applicable)

____ ______________

Signature of Subject/Participant or Legal Representative **Date**

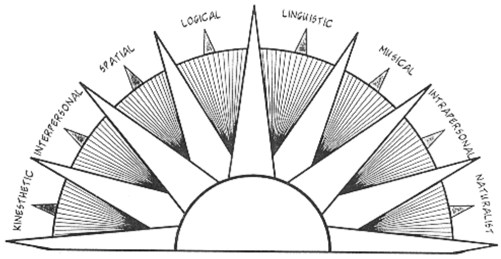
SIGNATURE OF INVESTIGATOR

I declare that I explained the information given in this document to __________________ [*name of the subject/participant]* and/or [his/her] representative ____________________ [*name of the representative]. [H*e/she] was encouraged and given ample time to ask me any questions. This conversation was conducted in English and no translator was used

____ ______________

Signature of Investigator **Date**

Addendum D: Multiple Intelligence Development Assessment Scale Questionnaire



M.I.D.A.S.

Multiple Intelligence Development Assessment Scale

Instructions

These questions will take about 20 minutes to answer. There are 8 areas of activities, skills and interests covered. Think of this as if you are interviewing yourself. You may be surprised by what you know about yourself when you think carefully.

For questions that give you several choices, pick the one activity you're strongest in and rate yourself on that only.

It is important that you give honest responses.

Be fair to yourself.

Do not under rate what you are able to do.

You do not have to answer or guess at every question because each one has an "I don't know or Does not apply" choice. Use this answer whenever it fits best for you. For example, some of the questions may ask about things you may not remember or you never got to do.

It's O.K. to respond that you do not know.

Student Research no: ___________

Musical:

1. As a child, did you have a strong liking for music or music classes?

- ☐ A little
- ☐ Sometimes
- ☐ Usually
- ☐ Often
- ☐ All the time
- ☐ I don't know

2. Did you ever learn to play an instrument?

- ☐ No
- ☐ A little
- ☐ Fair
- ☐ Good
- ☐ Excellent
- ☐ I don't know

3. Can you sing 'in tune'?

- ☐ A little bit
- ☐ Fair
- ☐ Well
- ☐ Very well
- ☐ Excellent
- ☐ I don't know

4. Do you have a good voice for singing with other people in harmony?

- ☐ A little bit
- ☐ Fair
- ☐ Well
- ☐ Very well
- ☐ Excellent
- ☐ I don't know

5. Did you ever play an instrument, play with a band or sing with a group?

- ☐ Never
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all of the time
- ☐ I don't know. Does not apply

6. Do you spend a lot of time listening to music?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

7. Do you ever make up songs of write music?

- ☐ Never
- ☐ Once or twice
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ I don't know

8. Do you ever drum your fingers, whistle or sing to yourself?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

9. Do you often have favourite tunes on your mind?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

10. Do you often like to talk about music?

- ☐ Never
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Nearly all the time
- ☐ I don't know

11. Do you have a good sense of rhythm?

- ☐ Fair
- ☐ Pretty good
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know

12. Do you have a strong liking for the SOUND of certain instruments or musical groups?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

13. Do you think you have a lot of musical talent or skill that hasn't been brought out?

- ☐ No
- ☐ Some
- ☐ A fair amount
- ☐ A good amount
- ☐ A great deal
- ☐ I don't know

14. Do you often have music on while you work, study of relax?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Usually
- ☐ Almost always
- ☐ Always
- ☐ I don't know

Kinesthetic

15. In School, did you generally enjoy sports or gym class more than other school classes?

- ☐ Not at all
- ☐ A little
- ☐ About the same
- ☐ Enjoy sports more
- ☐ Enjoy sports much more
- ☐ I don't know

16. How often do you play sports of other physical activities?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost always
- ☐ All the time
- ☐ I don't know or does not apply

17. Have you ever performed in a school play or taken lessons in acting or dancing?

- ☐ Never
- ☐ Maybe once
- ☐ A couple of times
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know

18. Do you or other people (like a coach) think that you are coordinated, graceful or a good athlete?

- ☐ No
- ☐ Maybe a little
- ☐ About average
- ☐ Better that average
- ☐ Superior
- ☐ I don't know

19. Did you ever take lessons of have someone teach you a sport such as bowling, karate, golf, etc.?

- ☐ No
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Nearly all the time
- ☐ I don't know

20. Have you ever joined teams to play a sport?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know

21. Do you often do physical work or exercise?

- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know or does not apply

22. Are you good with your hands at things like card shuffling, magic tricks or juggling?

- ☐ Not very good
- ☐ Fair
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know

23. Are you good at doing precise work with your hands such as sewing, making models, carving things out of wood, typing or have a good handwriting?

- ☐ Not at all
- ☐ Fairly good
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know

24. Do you enjoy working with your hands on projects such as mechanics, building things, preparing food of sculptures?

- ☐ Never or rarely
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know or does not apply

25. Are you good at using your body or face to imitate people such as teachers, friends or family?

- ☐ Not at all
- ☐ Fairly good
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know

26. Are you a good dancer, cheerleader or gymnast?

- ☐ Not at all
- ☐ Fairly good
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know

27. Do you learn better by having something explained to you or by doing it yourself?

- ☐ Always better by explanation
- ☐ Sometimes better by explanation
- ☐ No difference
- ☐ Usually better by doing it
- ☐ Always better by doing it
- ☐ I don't know

Logic/Math

28. As a child, did you easily learn math such as addition, multiplication and fractions?

- ☐ Not at all
- ☐ It was fairly hard
- ☐ Pretty easy
- ☐ Very easy
- ☐ Learned much quicker than all the kids
- ☐ I don't know

29. Have you ever had extra interest or skill in math?

- ☐ Very little or none
- ☐ Maybe a little
- ☐ Some
- ☐ More than average
- ☐ A lot
- ☐ I don't know

30. How have you done in advanced math classes such as algebra or calculus?

- ☐ Didn't take any
- ☐ Not very well
- ☐ Fair (C's)
- ☐ Well (B's)
- ☐ Excellent (A's)
- ☐ I don't know or does not apply

31. Have you ever had interest in studying science or solving scientific problems?

- ☐ No
- ☐ A little
- ☐ Average
- ☐ More than average
- ☐ A great deal
- ☐ I don’t know

32. Are you good at playing chess or checkers?

- ☐ No
- ☐ Fairly good
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don’t know

33. Are you good at playing cards or solving strategy or puzzle-type games?

- ☐ Not at all
- ☐ A little
- ☐ About average
- ☐ Better than average
- ☐ Excellent
- ☐ I don’t know

34. Do you often play games such as Scrabble or crossword puzzles?

- ☐ Very rarely or never
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ All the time
- ☐ I don't know. No opportunity

35. Do you have a good system for managing your money or figuring a budget?

- ☐ Not at all
- ☐ Fairly good
- ☐ Good
- ☐ Very good
- ☐ An excellent system
- ☐ I don't know or does not apply

36. Do you have a good memory for numbers such as telephone numbers or addresses?

- ☐ Not very good
- ☐ Fair
- ☐ Good
- ☐ Very good
- ☐ Superior
- ☐ I don't know

37. How are you at figuring numbers in your head?

- ☐ Cannot do it
- ☐ Not very good
- ☐ Fair
- ☐ Good
- ☐ Excellent
- ☐ I don't know

38. Are you a curious person who likes to figure out WHY or HOW things work?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

39. Are you good at inventing 'systems' for solving long or complicated problems? For example, organizing a room or big projects?

- ☐ Not very good
- ☐ Fair
- ☐ Good
- ☐ Better than average
- ☐ Excellent
- ☐ I don't know

40. Are you curious about nature like fish, animals, plants or the stars and planets?

- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

41. Have you ever liked to collect things and learn all there is to know about a certain subject such as horses, baseball, etc.?

- ☐ Not at all
- ☐ A little
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know

42. Are you good at jobs or projects where you have to use math a lot or get things organized?

- ☐ Not good at all
- ☐ Fairly good
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know. No opportunity

43. Outside of school, have you ever enjoyed working with numbers like figuring baseball averages, gas mileage, budgets, etc.?

- ☐ Not at all
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know

44. Do you use good common sense for planning social activities, making home repairs, or solving mechanical problems?

- ☐ Sometimes
- ☐ Usually
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

Spatial

45. As a child, did you often build things out of blocks or boxes, play with jacks, marbles or jump rope?

- ☐ Never or rarely
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

46. How well can you do any of these: mechanical drawing, hair styling, woodworking, art projects, auto body, or mechanics?

- ☐ Didn't take any
- ☐ Fair
- ☐ Good. (C's)
- ☐ Very good. (B's)
- ☐ Excellent. (A's)
- ☐ I don't know

47. How well can you 'design' things such as arranging or decorating rooms, craft projects, building furniture or machines?

- ☐ Never do
- ☐ Fair
- ☐ Pretty good
- ☐ Good
- ☐ Excellent
- ☐ I don't know

48. Can you parallel park a car on your first try?

- ☐ Rarely or do not drive
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know. No opportunity

49. Are you good at finding your way around new buildings or city streets?

- ☐ Not at all
- ☐ Fairly good
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know

50. Are you good at using a road map to find your way around?

- ☐ Not at all
- ☐ Fairly good
- ☐ Good
- ☐ Very good
- ☐ Excellent at map reading
- ☐ I don't know

51. Are you good at fixing 'things' like cars, lamps, furniture, or machines?

- ☐ Not at all
- ☐ Not very good
- ☐ Fair
- ☐ Good
- ☐ Excellent
- ☐ I don't know

52. How easily can you put things together like toys, puzzles, or electronic equipment?

- ☐ Not at all
- ☐ It is hard
- ☐ It is fairly easy
- ☐ It is easy
- ☐ It is very easy
- ☐ I don't know

53. Have you ever made your own plans or patterns for projects such as sewing, carpentry, crochet, woodworking, etc.?

- ☐ Never
- ☐ Maybe once
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ I don't know

54. Have you ever drawn or painted pictures?

- ☐ Rarely or never
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know. No opportunity

55. Do you have a good sense of design for decorating, landscaping or working with flowers?

- ☐ Not very good
- ☐ Fair
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know

56. Do you have a good sense of direction when in a strange place?

- ☐ Not at all
- ☐ Fairly good
- ☐ Good
- ☐ Very good
- ☐ Superior
- ☐ I don't know

57. Are you good at playing pool, darts, riflery, archery, bowling, etc.?

- ☐ Not at all
- ☐ A little
- ☐ Fair
- ☐ Better than average
- ☐ Excellent
- ☐ I don't know

58. Do you often draw a picture or sketch to give directions or explain an idea?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ All the time
- ☐ I don't know

59. Are you creative and like to invent or experiment with unique designs, clothes or projects?

- ☐ Very little or not at all
- ☐ A little
- ☐ Somewhat
- ☐ Often
- ☐ Almost all the time
- ☐ I'm don't know

Linguistic

60. Do you enjoy telling stories or talking about favourite movies or books?

- ☐ Not at all
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I'm not sure

61. Do you ever play with the sounds of words like making up jingles, or rhymes? For example, do you give things or people funny sounding nicknames?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ All the time
- ☐ I don't know

62. Do you use colourful words or phrases when talking?

- ☐ No
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ All the time
- ☐ I don't know

63. Have you ever written a story, poetry or words to songs?

- ☐ Never
- ☐ Maybe once or twice
- ☐ Occasionally
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know

64. Are you a convincing speaker?

- ☐ Not at all
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all of the time
- ☐ I don't know

65. How are you at bargaining or making a deal with people?

- ☐ Not very good
- ☐ Fair
- ☐ Pretty good
- ☐ Good
- ☐ Excellent
- ☐ I don't know

66. Can you talk people into doing things your way when you want to?

- ☐ Not at all
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I'm not sure

67. Do you ever do public speaking or give talks to groups?

- ☐ Very rarely or never
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know

68. How are you at managing or supervising people?

- ☐ Never do or not very good at it
- ☐ Fair
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know or does not apply

69. Do you have interest for talking about things like the news, family matters, religion or sports, etc.?

- ☐ A little
- ☐ Some interest
- ☐ Average interest
- ☐ More than average
- ☐ A great deal
- ☐ I don't know

70. When others disagree are you able to easily say what you think or feel?

- ☐ Rarely
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ All the time
- ☐ I don't know

71. Do you enjoy looking up words in dictionaries, or arguing with others about "the right word" to use?

- ☐ Never or rarely
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Very often
- ☐ I don't know

72. Are you often the one asked to "do the talking" by family or friends because you are good at it?

- ☐ Very rarely or never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know

73. Have you ever been good at imitating the way other people talk?

- ☐ Not really
- ☐ Fairly good
- ☐ Pretty good
- ☐ Good
- ☐ Very good
- ☐ I don't know

74. Have you ever been good at writing reports for school or work?

- ☐ Not really. Never do any
- ☐ Pretty good
- ☐ Good
- ☐ Very good
- ☐ Superior
- ☐ I don't know

75. Can you write a good letter?

- ☐ No or fair
- ☐ Pretty good
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know

76. Do you like to read or do well in English classes?

- ☐ A little
- ☐ Sometimes
- ☐ Usually
- ☐ Often
- ☐ All the time
- ☐ I don't know

77. Do you write notes or make lists as reminders of things to do?

- ☐ Rarely or never
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ I don't know

78. Do you have a large vocabulary?

- ☐ Not really
- ☐ Less than average
- ☐ About average
- ☐ Above average
- ☐ Superior
- ☐ I don't know

79. Do you have skill for choosing the right words and speaking clearly?

- ☐ Not at all or rarely
- ☐ Sometimes
- ☐ Usually
- ☐ Most of the time
- ☐ Almost always
- ☐ I don't know

Interpersonal

80. Have you had friendships that have lasted for a long time?

- ☐ One or two
- ☐ More than a couple
- ☐ Quite a few
- ☐ A lot
- ☐ A great many long lasting friendships
- ☐ I don't know

81. Are you good at making peace at home, at work or among friends?

- ☐ Fair
- ☐ Pretty good
- ☐ Good
- ☐ Very good
- ☐ Excellent
- ☐ I don't know

82. Are you ever a 'leader' for doing things at school, among friends or at work?

- ☐ Rarely
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost always
- ☐ I don't know

83. In school, were you usually part of a particular group or crowd?

- ☐ Rarely
- ☐ Every once in a while
- ☐ Sometimes
- ☐ Most of the time
- ☐ Almost all the time
- ☐ I don't know

84. Do you easily understand the feelings, wishes or needs of other people?

- ☐ Sometimes
- ☐ Usually
- ☐ Often
- ☐ Almost always
- ☐ Always
- ☐ I don't know

85. Do you ever offer to 'help' other people such as the sick, the elderly or friends?

- ☐ Sometimes
- ☐ Usually
- ☐ Often
- ☐ Very often
- ☐ Always
- ☐ I don't know

86. Do friends or family members ever come to you to talk over personal troubles or to ask for advice?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Often
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

87. Are you a good judge of 'character'?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Usually
- ☐ Almost always
- ☐ Always
- ☐ I don't know

88. Do you usually know how to make people feel comfortable and at ease?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Usually
- ☐ Almost always
- ☐ Always
- ☐ I don't know

89. Do you generally take the good advice of friends?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Usually
- ☐ Often
- ☐ Almost always
- ☐ I don't know

90. Are you generally at ease around (men or women) your own age?

- ☐ Rarely
- ☐ Sometimes
- ☐ Usually
- ☐ Almost all the time
- ☐ Always
- ☐ I don't know

91. Are you good at understanding your (girlfriend's or wife's) (boyfriend's or husband's) ideas and feelings?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Usually
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know. Does not apply

92. Are you an easy person for people to get to know?

- ☐ Not at all
- ☐ Pretty hard
- ☐ Fairly easy
- ☐ Easy
- ☐ Very easy
- ☐ I don't know

93. Do you have a hard time coping with children?

- ☐ Usually have a hard time
- ☐ Sometimes it is hard
- ☐ Usually easy
- ☐ Almost always easy
- ☐ Always very easy
- ☐ I don't know

94. Have you ever had interest in teaching, coaching or counselling?

- ☐ Very little or none
- ☐ A little interest
- ☐ Some interest
- ☐ A lot of interest
- ☐ A great deal of interest
- ☐ I don't know or doesn't apply

95. Can you do well when working with the public in jobs such as sales, receptionist, promoter, police, or waiter?

- [ ] Fair
- [ ] Fairly well
- [ ] Well
- [ ] Very well
- [ ] Excellent
- [ ] I don't know. Does not apply

96. Do you prefer working alone or with a group of people?

- [ ] Always alone
- [ ] Usually alone
- [ ] No preference
- [ ] Usually with a group
- [ ] Always with a group
- [ ] I don't know

97. Are you able to come up with unique or imaginative ways to solve problems between people or settle arguments?

- [ ] Maybe once or twice
- [ ] Every once in a while
- [ ] Sometimes
- [ ] Often
- [ ] All the time
- [ ] I don't know

Intrapersonal

98. Do you have a clear sense of who you are and what you want out of life?

- [ ] Very little
- [ ] A little
- [ ] Usually
- [ ] Most of the time
- [ ] Almost all the time
- [ ] I don't know

99. Are you aware of your feelings and able to control your moods?

- [ ] Every once in a while
- [ ] Sometimes
- [ ] Most of the time
- [ ] Almost all the time
- [ ] Always
- [ ] I don't know

100. Do you plan and work hard toward personal goals like at school, at work or at home?

- ☐ Rarely
- ☐ Sometimes
- ☐ Usually
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

101. Do you 'know your own mind' and do well at making important personal decisions such as choosing classes, changing jobs or moving?

- ☐ No or every once in a while
- ☐ Sometimes
- ☐ Usually
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

102. Are you happy with the work you choose because it matches your skills, interests and personality?

- ☐ No or rarely
- ☐ Sometimes
- ☐ Usually
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

103. Do you generally know what you are good at (or not good at) doing and try to improve your skills?

- ☐ Every once in a while
- ☐ Sometimes
- ☐ Usually
- ☐ Almost all the time
- ☐ All the time
- ☐ I don't know

104. Do you get very angry when you fail or are frustrated?

- ☐ Almost all the time
- ☐ Sometimes
- ☐ Every once in a while
- ☐ Rarely
- ☐ Almost never
- ☐ I don't know

105. Have you ever had interest in 'self-improvement'? For instance, do you attend classes to learn new skills or read 'self-help' books or magazines?

- [ ] No
- [ ] A little
- [ ] Sometimes
- [ ] Often
- [ ] Almost always
- [ ] I don't know

106. Have you ever been able to find unique or unusual ways to solve personal problems or achieve your goals?

- [ ] Once or twice
- [ ] Every once in a while
- [ ] Sometimes
- [ ] Often
- [ ] All the time
- [ ] I don't know

Naturalist

107. Have you ever raised pets or other animals?

- [ ] Never or rarely
- [ ] Every once in a while
- [ ] Sometimes
- [ ] Often
- [ ] All the time
- [ ] I don't know

108. Is it easy for you to understand and care for an animal?

- [ ] Not at all
- [ ] Maybe a little
- [ ] Fairly easy
- [ ] Quite easy
- [ ] Very easy
- [ ] I don't know

109. Have you ever done any pet training, hunting or studied wildlife?

- [ ] No
- [ ] A little
- [ ] Sometimes.
- [ ] Quite a bit
- [ ] A great deal
- [ ] I don't know. No opportunity.

110. Are you good at working with farm animals or thought about being a veterinarian or naturalist?

- ☐ Not at all
- ☐ A little
- ☐ Some
- ☐ Quite a bit
- ☐ Very much so
- ☐ I don't know

111. Do you easily understand differences between animals such as personalities, traits or habits?

- ☐ Not at all
- ☐ A little
- ☐ Fairly easy
- ☐ Quite easy.
- ☐ Very easy
- ☐ I don't know

112. Are you good at recognizing breeds of pets or kinds of animals?

- ☐ Not at all
- ☐ A little
- ☐ Somewhat
- ☐ Quite good
- ☐ Very good.
- ☐ I don't know

113. Are you good at observing and learning about nature, for example, clouds, weather patterns, animal or plant life?

- ☐ Never
- ☐ A little
- ☐ Some
- ☐ Quite a bit
- ☐ A great deal
- ☐ I don't know

114. Are you good at growing plants or raising a garden?

- ☐ Not at all
- ☐ A little
- ☐ Somewhat
- ☐ Quite a bit
- ☐ Very good
- ☐ I don't know

115. Can you identify or understand the differences between types of plants?

- [ ] Not at all
- [ ] A little
- [ ] Somewhat
- [ ] Most of the time, yes
- [ ] All the time
- [ ] I don't know

116. Are you fascinated by natural energy systems such as chemistry, electricity, engines, physics or geology?

- [ ] No
- [ ] A little
- [ ] Somewhat
- [ ] Quite a bit
- [ ] A great deal
- [ ] I don't know

117. Do you have a concern for nature and do things like recycling, camping, hiking or bird watching?

- [ ] No
- [ ] A little
- [ ] Some
- [ ] A lot
- [ ] A great deal
- [ ] I don't know

118. Have you taken photographs of nature or written stories or done artwork?

- [ ] No
- [ ] A little
- [ ] Some
- [ ] A lot
- [ ] A great deal
- [ ] I don't know

119. Is spending time with nature an important part of your life?

- [ ] Not really
- [ ] A little
- [ ] Somewhat
- [ ] Quite a bit
- [ ] Very much so
- [ ] I don't know

You're finished!

Addendum E: MIDAS scores of all the participants

Research no	Linguistic	Interpersonal	Intrapersonal	Mathematical	Spatial	Musical	Kinesthetic	Naturalist
1	50	63	52	43	38	25	23	47
2	36	44	35	25	11	27	23	14
3								
4	51	63	56	41	48	56	23	44
5	38	63		46	25	14	11	43
6	39	59	51	49	47	38	23	66
7	37	75	64	36	41	39	38	59
8	55	72	65	55	50	61	65	54
9	47	80	63	70	22	48	46	38
10	33	78	62	45	25	23	15	41
11	43	53	55	42	37	50	31	22
12	46	66	45	47	36	38	38	23
13	62	63	75	69	61	35	63	72
14	88	88	79	63	36	82	58	61
15	42	47	55	59	44	25	46	55
16	49	70	64	53	58	29	42	66
17	75	87	66	56	52	86	79	67
18	26	57	57	63	20	29	25	30
19	47	51	55	47	6	23	18	8
20	51	66	61	51	23	61	33	34
21	66	71	60	53	50	60	21	70
22	62	84	66	34	27	55	23	57
23	59	71	76	76	92	71	63	48
24	21	22	25	22	17	23	5	41
25	25	49	43	44	44	41	48	44

Addendum F: Design assignments 1, 2, 3, 4 and 5 assessment rubrics

Design Assignment 1 Assessment Rubric:

DESIGN PRINCIPLE: EMPHASIS

The student had to design two separate, 20 x 20cm compositions to illustrate the meaning of the design principle, emphasis. The one composition must have emphasis and the other one must not have emphasis in it. Use the "Without Emphasis" composition to evaluate the "With Emphasis" composition against.

1	2	3	4	5
There is no indication of emphasis in the composition. The design idea/solution did not satisfy the design requirements.	Possible but very little traces of emphasis in the composition. The design idea/solution did not satisfy the design requirements.	Indication of emphasis in the composition. The design idea/solution did satisfy the design requirements.	Clear indication of emphasis in the composition. The design idea/solution did satisfy the design requirements.	Excellent example of emphasis in the composition. The design idea/solution did satisfy the design requirements

Design Assignment 2 Assessment Rubric:

DESIGN PRINCIPLE: EMPHASIS

Assignment Title: SHOW THE ***HEART*** OF DESIGN. The students was invited to participate in a design exhibition.

All the students had to create **two** compositions. Each composition must **lead the viewer** to the heart of the design. Each composition must use *different methods of controlling* the attention of the viewer towards the **focal** point.

1	2	3	4	5
None of the methods indicate emphasis in the composition. The design idea/solution did not satisfy the design requirements.	There was very little comparison between the method used and the indication of emphasis in the composition. The design idea/solution did not satisfy the design requirements.	One or both compositions indicate emphasis but, there is either: no difference in the methods used, wrong or no indication of the method used. The design idea/solution did satisfy the design requirements.	Both compositions indicate different methods of emphasis and was correctly labelled. The design idea/solution did satisfy the design requirements.	Excellent example of the different methods to create emphasis in the composition. The design idea/solution did satisfy the design requirements

Design Assignment 3 Assessment Rubric:

DESIGN PRINCIPLE: Symmetry and Balance

Assignment Title: Mirror - rorriM

All the designers must create **two** compositions. Each composition must **indicate a method of symmetry in design**

1	2	3	4	5
None of the methods indicate symmetry in the composition. The design idea/solution did not satisfy the design requirements.	There was very little comparison between the method used and the indication of symmetry in the composition. The design idea/solution did not satisfy the design requirements.	One or both compositions indicate symmetry but, there is either: no difference in the methods used, wrong or no indication of the method used. The design idea/solution did satisfy the design requirements.	Both compositions indicate different methods of symmetry and was correctly labelled. The design idea/solution did satisfy the design requirements.	Excellent example of the different methods to create symmetry in the composition. The design idea/solution did satisfy the design requirements

Design Assignment 4 Assessment Rubric:

DESIGN PRINCIPLE: Rhythm

Assignment Title: Let the Rhythm move you!

All the designers must create **two** compositions. Each composition must indicate how rhythm create movement in design.

The different types of rhythm we did: Regular, Alternating and Progressive, see notes for detail descriptions.

STUDENT RESEARCH NO:_______________

1	2	3	4	5
None of the methods indicate rhythm in the composition. The design idea/solution did not satisfy the design requirements.	There was very little comparison between the method used and the indication of rhythm in the composition. The design idea/solution did not satisfy the design requirements.	One or both compositions indicate rhythm but, there is either: no difference in the methods used, wrong or no indication of the method used. The design idea/solution did satisfy the design requirements.	Both compositions indicate different methods of rhythm and was correctly labelled. The design idea/solution did satisfy the design requirements.	Excellent example of the different methods to create rhythm in the composition. The design idea/solution did satisfy the design requirements

Design Assignment 5 Assessment Rubric:

DESIGN PRINCIPLE: Scale and Proportion

Assignment Title: Size matters!

All the designers must create **two** compositions. The 1st composition must imply authority through scale. The 2nd composition must create the illusion of depth through scale.

See notes for detail descriptions.

STUDENT RESEARCH NO:_______________

1	2	3	4	5
None of the artefacts indicated the role of scale in the composition. The design idea/solution did not satisfy the design requirements.	There was very little comparison between the artefact and the required concept in the composition. The design idea/solution did not satisfy the design requirements.	Only one composition represented a correct concept. The design idea/solution did satisfy the design requirements.	Both compositions represented the required concepts. The design idea/solution did satisfy the design requirements.	Excellent examples of the different concepts in the composition. The design idea/solution did satisfy the design requirements

Addendum G: Briefs for design assignments 1, 2, 3, 4 and 5

Design Assignment 1 Brief:

DESIGN PRINCIPLES: EMPHASIS

Think of what the word **emphasis** mean to you as an aspiring designer.

Design two separate, 20 x 20cm compositions, to illustrate the meaning of the design principles, emphasis. The one composition must have emphasis and the other one must not have emphasis

Use only the three primary shapes (circle, square and triangle) in your compositions. You can manipulate the shapes in terms of the number of shapes used, the sizes of the shapes, and the position of the shapes.

Use the cut outs of all the provided shapes.

Remember to write only your research number on the page provided.

Design Assignment 2 Brief:

SHOW THE ***HEART*** OF DESIGN

You are invited to participate in a design exhibition.

All the designers must create **two** compositions. Each composition must **lead the viewer** to the heart of the design. Each composition must use *different methods of controlling* the attention of the viewer towards the **focal** point.

Use only the three primary shapes (circle, square and triangle) in your compositions. You can manipulate the shapes in terms of the number of shapes used, the sizes of the shapes, and the position of the shapes. Use the cut outs of all the provided shapes.

Study all the analogies (examples) to guide your design process!

Design Assignment 3 Brief:

Mirror – rorriM

You are invited to participate in a design exhibition.

All the designers must create **two** compositions. Each composition must **indicate a method of symmetry in design.**

Use only the three primary shapes (circle, square and triangle) in your compositions. You can manipulate the shapes in terms of the number of shapes used, the sizes of the shapes, and the position of the shapes. Use the cut outs of all the provided shapes.

Study all the analogies (examples) to guide your design process!

Design Assignment 4 Brief:

Let the **Rhythm** move you!

You are invited to participate in a design exhibition.

All the designers must create **two** abstract compositions. Each composition must **indicate how rhythm create movement in design.**

Write down the rhythm method you used in each composition!

Use only the three primary shapes (circle, square and triangle) in your compositions. You can manipulate the shapes in terms of the number of shapes used, the sizes of the shapes, and the position of the shapes. Use the cut outs of all the provided shapes.

Study all the analogies (examples) to guide your design process!

<u>Design Assignment 5 Brief</u>:

size matters!

You are invited to participate in a design exhibition.

All the designers must create **two** abstract compositions. The 1st composition must imply authority through scale. The 2nd composition must create the illusion of depth through scale.

Use only the three primary shapes (circle, square and triangle) in your compositions. You can manipulate the shapes in terms of the number of shapes used, the sizes of the shapes, and the position of the shapes. Use the cut outs of all the provided shapes.

Study all the analogies (examples) to guide your design process!

Remember to write only your research number on the page provided.

Addendum H: Design assignments 1,2,3,4 and 5 results

	Design Assignment 1			Design Assignment 2			Design Assignment 3			Design Assignment 4			Design Assignment 5		
Research no	**Average**	*Assessor 1*	*Assessor 2*	**Average**	*Assessor 1*	*Assessor 2*	**Average**	*Assessor 1*	*Assessor 2*	**Average**	*Assessor 1*	*Assessor 2*	**Average**	*Assessor 1*	*Assessor 2*
1	1.5	2	1	0	0	0	4.5	4	5	3	3	3	4.5	4	5
2	0	0	0	3	3	3	4.5	5	4	3	3	3	5	5	5
3	0	0	0	0	0	0	0	0	0	0	0	0	4.5	5	4
4	1.5	1	2	3.5	3	4	4	5	3	3	3	3	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2	2	2	3	3	3	4	4	4	3	3	3	4.5	5	4
7	2.5	3	2	2.5	2	3	3	3	3	3	3	3	0	0	0
8	1.5	1	2	2.5	3	2	4.5	5	4	3.5	3	4	3.5	4	3
9	2.5	3	2	4	4	4	5	5	5	3	3	3	3	3	3
10	1.5	1	2	3	3	3	3	3	3	0	0	0	4	5	3
11	2	2	2	3	3	3	2.5	3	2	0	0	0	3.5	4	3
12	3	3	3	3	3	3	4	4	4	3	3	3	4	4	4
13	0	0	0	0		0	0	0	0	0	0	0	0	0	0
14	0	0	0	4	4	4	4.5	5	4	3	3	3	4.5	4	5
15	1.5	1	2	3	3	3	4	4	4	2.5	3	2	0	0	0
16	4	4	4	3	3	3	4.5	4	5	3	3	3	0	0	0
17	3	2	4	3	3	3	3.5	4	3	0	0	0	3	3	3
18	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3
19	1	1	1	2.5	3	2	2.5	3	2	0	0	0	0	0	0
20	1	1	1	3	3	3	4	4	4	2.5	3	2	3.5	4	3
21	2.5	2	3	3.5	3	4	3	3	3	3	3	3	4	4	4
22	1.5	1	2	3.5	3	4	4	3	5	3	3	3	4	4	4
23	2.5	2	3	3	3	3	3.5	4	3	3	3	3	4.5	5	4
24	1	1	1	4.5	4	5	0	0	0	3	3	3	4	5	3
25	1.5	1	2	3	3	3	4	4	4	3	3	3	3.5	3	4

Addendum I: Preparatory assignment and reader

Rhythms in Nature by John Breukelman[156]

The dictionaries, both popular and technical, list many definitions for the word "rhythm." Most of these definitions are in the fields of speech, music, sound, marching cadence, and the like, but rhythms occur in nature also. A rhythm is a natural movement or change characterized by alternations or "ups and downs" that occur at more or less regular intervals. In technical books and articles such natural rhythm is often called "periodicity" or "periodism." The term "cycle" is also used to denote a series of regularly recurring events or changes. In different science books these terms are used more or less as synonyms; it would be more confusing than enlightening to try to distinguish among them for our present purposes.

Rhythms are equally common and familiar in the physical (inanimate or non-living) world and in the living world. In a broad sense, the major changes occurring in the earth and solar system are rhythmic. No one knows how closely the various rhythms of the physical world are related to one another, or how closely the rhythms of living things are tied to those of the physical world. We have much conflicting evidence, for example, about the influence of sun spot cycles on such other rhythms as annual rainfall variations, changes in atmospheric radioactivity, and changes in total solar energy that reaches the earth. These may in turn influence tree growth, bird migration, types and frequencies of human diseases, and other rhythmic changes in living things.

SOME RHYTHMS IN THE PHYSICAL WORLD

In the physical world we see light and dark alternating in a 24hour rhythm, the progression of the seasons as the earth swings annually in its orbit about the sun, the precise cycle of new moon, first quarter, full moon, and last quarter as the moon travels around the earth once each lunar month, the much less precise daily variations in temperature and humidity, and the year-by-year changes in precipitation which are so irregular that many people think they should not even be called rhythms or cycles.

Tidal Rhythms

Although we are not aware of them, people who live near the seashore adjust many o£ their activities to the tidal rhythms -two high tides per day, about 12 1/2 hours apart. They have also noticed that the moon has much more to do with tides than the sun. As the moon rises about 50 minutes later each day, so is each high tide about 50 minutes later than it was the day before. The monthly tidal cycle also matches that of the moon. Twice each month, when the moon is new and when it is full, the difference between high tide and low tide is greatest. This is called the spring tide. Likewise, when the moon is at first and last quarter, the difference between high and low tide is the least. This is called the neap tide. At spring tide the sun, moon, and earth are in line; the sun and moon "pull together." At neap tide the sun and moon "pull" at right angles to each other.

SOME RHYTHMS IN THE LIVING WORLD

Rhythms are as common in the living world as in the sun, plants, and earth. The daily and seasonal changes in light, atmospheric pressure, temperature, humidity, and other environmental factors are rather pronounced in all environments except deep water, the deeper layers of soil, and the larger and deeper caves. Most plants and animals live in environments with rhythmic changes, and they make daily or seasonal adjustments to the changing surroundings. Familiar examples are the butterflies, most of which are active by day, and the closely related moths, most of which are active by night. Many animals are active during certain parts of the day and rest other times. Although it is not generally

[156] www.emporia.edu/ksn/v08n1-november1961/index.html

known, many plants also have "sleep movements." These are too slow to see directly, but may be detected by examining plants at intervals by day and by night, or recorded photographically.

Heart Beat

One of the most familiar of all the rhythms of life is that of the beating of the heart. Each of us can be aware of this rhythm by feeling his own pulse. The heart beat is not merely contraction and relaxation of a single muscle. Contraction starts in a little islet of special tissue in the right auricle and passes wavelike over the entire heart. Complicated electrical changes accompany each heartbeat. With suitable instruments these electrical changes can be recorded on a' moving strip of paper. The instrument ordinarily used for clinical and research purposes is an electrocardiograph and the record produced by the instrument is an electrocardiogram.

Assignment:

Rhythms in Nature

Research no: ___________________

After reading the text about Rhythms in Nature, find an example of Rhythm in Nature and draw it.

Write also a short paragraph why that example inspired you, what was on the reason you selected that specific example and how that example created rhythm.

Drawing:

Paragraph:

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